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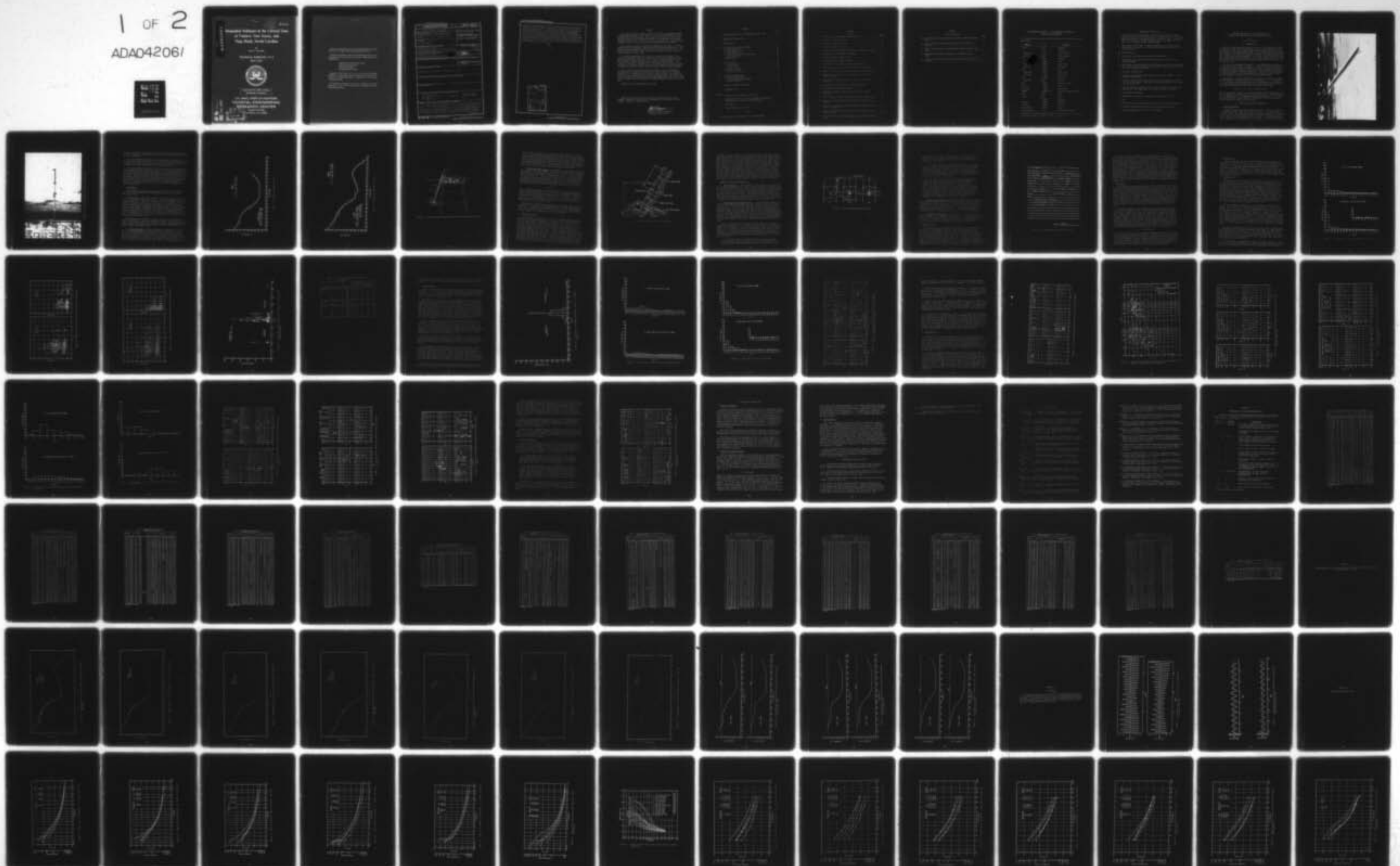

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TP 77-5

Suspended Sediment in the Littoral Zone at Ventnor, New Jersey, and Nags Head, North Carolina

by
John C. Fairchild

TECHNICAL PAPER NO. 77-5
MAY 1977

U.S. ARMY, CORPS OF ENGINEERS
COASTAL ENGINEERING
RESEARCH CENTER
Kingman Building
Fort Belvoir, Va. 22060

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: TP 77-5 (14) CERC-TP-77-5
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:
4. TITLE (and Subtitle): (6) SUSPENDED SEDIMENT IN THE LITTORAL ZONE AT VENTNOR, NEW JERSEY, AND NAGS HEAD, NORTH CAROLINA.
5. TYPE OF REPORT & PERIOD COVERED: (9) Technical Paper,
6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): (10) John C. Fairchild
8. CONTRACT OR GRANT NUMBER(s):
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Department of the Army, Coastal Engineering Research Center (CERRE-CP), Kingman Building, Fort Belvoir, Virginia 22060
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: D31196 (12) 99p.
11. CONTROLLING OFFICE NAME AND ADDRESS: Department of the Army, Coastal Engineering Research Center, Kingman Building, Fort Belvoir, Virginia 060 (11)
12. REPORT DATE: Apr[redacted]77
13. NUMBER OF PAGES: 97
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):
15. SECURITY CLASS. (of this report): UNCLASSIFIED
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:
16. DISTRIBUTION STATEMENT (of this Report):

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report):
18. SUPPLEMENTARY NOTES:
19. KEY WORDS (Continue on reverse side if necessary and identify by block number):

Longshore transport
Nags Head, North Carolina
Pump sampler
Sand sampling
Suspended sediment
Ventnor, New Jersey
Waves

20. ABSTRACT (Continue on reverse side if necessary and identify by block number):

Suspended-sediment samples were collected in and near the surf zone from Jennette's Pier, Nags Head, North Carolina, and the City Pier, Ventnor, New Jersey, using a tractor-mounted pump sampler. Maximum suspended-sediment concentrations at Ventnor ranged up to 2.6 parts per thousand by weight, and at Nags Head up to about 4.0 parts per thousand. As in previous studies, the log of concentration decreased linearly with elevation above bottom for

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samples away from the bottom, but near-bottom concentration was higher than the extrapolated log trend. Concentration increased as local height-to-depth ratio increased, to a maximum near the theoretically predicted maximum height-to-depth ratio. Plunging breakers appear to suspend more sediment than spilling breakers. Median sand size at Ventnor ranged from 0.12 to 0.15 millimeter and at Nags Head averaged about 0.21 millimeter. The median size of suspended-sediment samples was lower than bottom samples. Potential applications, including an example on longshore transport, are discussed. The results of this report are based on a total of 850 samples, each pumped for 2.5 to 3 minutes and more than half collected in the 0.2 to 0.5 foot range above the bottom.

PREFACE

This report provides coastal engineers with data on suspended-sediment concentration collected in and near the surf zones at Ventnor, New Jersey, and Nags Head, North Carolina. These data are of interest because a significant amount of sand eroded from beaches is transported in suspension through the surf zone. The work was carried out under the coastal processes program of the U.S. Army Coastal Engineering Research Center (CERC).

This report is based on a manuscript prepared by Mr. John C. Fairchild, Research Hydraulic Engineer, retired from the CERC Research Division. The manuscript was condensed for publication by Dr. Cyril J. Galvin, Jr., Chief, Coastal Processes Branch, under the general supervision of R.P. Savage, Chief, Research Division, CERC.

The author acknowledges the officials of the City of Ventnor, New Jersey, including Mr. Kiger, City Engineer, who gave permission to collect data from the Ventnor City Pier, and G. Vavrek, Ventnor piermaster, for his personal assistance during data collection in 1965 and 1971. Data collection was made at Jennette's Pier, Nags Head, North Carolina, b permission of W. Jennette, and the Louisiana State University Coastal Studies Institute who was there under contract with the Office of Naval Research.

The assistance of the many CERC contributors is also acknowledged, particularly F.F. Monroe who performed the initial analysis of the Nags Head data; C.R. Schweppe and D.C. Fresch, student trainees, who prepared numerous scatter plots and performed other helpful tasks; L.E. Meyerle and M.G. Essick who were helpful in reducing and compiling the data; and B. Sims and M. Fleming who wrote programs for computer-generated plots of the field data.

Comments on this publication are invited.

Approved for publication in accordance with Public Law 166, 79th Congress, approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.

JOHN H. COUSINS
Colonel, Corps of Engineers
Commander and Director

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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U.S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	by	To obtain
inches	25.4	millimeters
	2.54	centimeters
square inches	6.452	square centimeters
cubic inches	16.39	cubic centimeters
feet	30.48	centimeters
	0.3048	meters
square feet	0.0929	square meters
cubic feet	0.0283	cubic meters
yards	0.9144	meters
square yards	0.836	square meters
cubic yards	0.7646	cubic meters
miles	1.6093	kilometers
square miles	259.0	hectares
knots	1.8532	kilometers per hour
acres	0.4047	hectares
foot-pounds	1.3558	newton meters
millibars	1.0197×10^{-3}	kilograms per square centimeter
ounces	28.35	grams
pounds	453.6	grams
	0.4536	kilograms
ton, long	1.0160	metric tons
ton, short	0.9072	metric tons
degrees (angle)	0.1745	radians
Fahrenheit degrees	5/9	Celsius degrees or Kelvins[1]

[1] To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use formula: $K = (5/9)(F - 32) + 273.15$.

SYMBOLS AND DEFINITIONS

C suspended-sediment concentration (in parts per thousand) by weight, given by the ratio of the total weight of sediment sample to the total weight of seawater in the pumped sample. Weight of water is determined from volume pumped, assuming seawater density of 64 pounds per cubic foot, less the weight of the sediment sample.

d water depth at the sampling station determined by surveying bottom elevation and subtracting it from the tidal stage at the time of sample collection

d_m median sand size

E distance of the intake nozzle above the ocean bottom

H wave height, the vertical distance between a wave crest and the preceding trough

H_s significant wave height determined from analysis of pen-and-ink records for a pressure gage located in a 15-foot water depth at the end of the City Pier at Ventnor, New Jersey

Q longshore transport rate

R distance scale measured along sampler pipe, used to compute E, nozzle elevation above bottom

S horizontal distance from the breaker line to the sampling station at the time of the sample. (Distances to stations landward of the breaker line are positive.)

S_s distance from the sampling station to the estimated stillwater level (SWL), based on the tide stage at the time of sample collection

T wave period (in seconds)

T_s significant wave period as determined in the analysis for H_s

t time

V_i velocity of the water-sediment mixture in the 0.5-inch intake nozzle

α_b estimated angle between breaking wave crest and the shoreline

θ angle of sampler pipe to vertical (in degrees)

SUSPENDED SEDIMENT IN THE LITTORAL ZONE AT VENTNOR, NEW JERSEY, AND NAGS HEAD, NORTH CAROLINA

by
John C. Fairchild

I. INTRODUCTION

Much of the sand transport along beaches occurs in suspensions. These suspensions are entrained by wave-induced water velocity near the bottom, particularly in the zone extending from seaward of the breaker line to the runup limit. Such suspensions are important to coastal engineering because, once suspended, the sand can be moved by currents with mean velocities too small to initiate sediment transport. For example, weak longshore currents may be very effective in transporting sand in the longshore direction, once that sand has been stirred up by the onshore-offshore motion of waves crossing the surf zone.

The relative importance of transport in such suspensions, measured as a fraction of total littoral transport, is presently unknown, but there is evidence that sand transport in suspension may be the significant fraction of longshore transport (Galvin, 1973). This study examines two extensive collections of data on sediment suspensions in the surf zone to determine the characteristics of such suspensions and to judge the relative importance of sediment suspensions to the total littoral transport.

The principal variables considered in this study are listed in Symbols and Definitions. The concentration of the suspension, C, is considered to be a dependent variable determined by an unknown function of sediment size (d_m), distance from breaker line (S), water depth (d), elevation above bottom (E), wave height (H), wave period (T), and breaker type:

$$C = f\ (d_m,\ S,\ d,\ E,\ H,\ T,\ \text{Breaker Type}) \quad . \qquad (1)$$

Most of this report attempts to isolate the effect of the independent variables, grouped as sediment size (d_m), position (S,d,E), and wave conditions (H, T, Breaker Type), on suspended-sediment concentration, C, for data collected from City Pier, at Ventnor, New Jersey, in 1965 and Jennette's Pier at Nags Head, North Carolina, in 1964.

II. FIELD DATA COLLECTION PROCEDURES

1. Piers and Profiles.

Suspended-sediment data were collected at several locations along the fishing pier at each of the study sites. Figure 1 is an aerial photo of Jennette's Pier. The length of the pier deck is about 780 feet (238 meters) and the deck elevation is about 18 feet (5.5 meters) above mean water level (MWL). Figure 2 is an aerial photo of City Pier. The length of the pier deck measured from the concrete wall on the landward side of the boardwalk

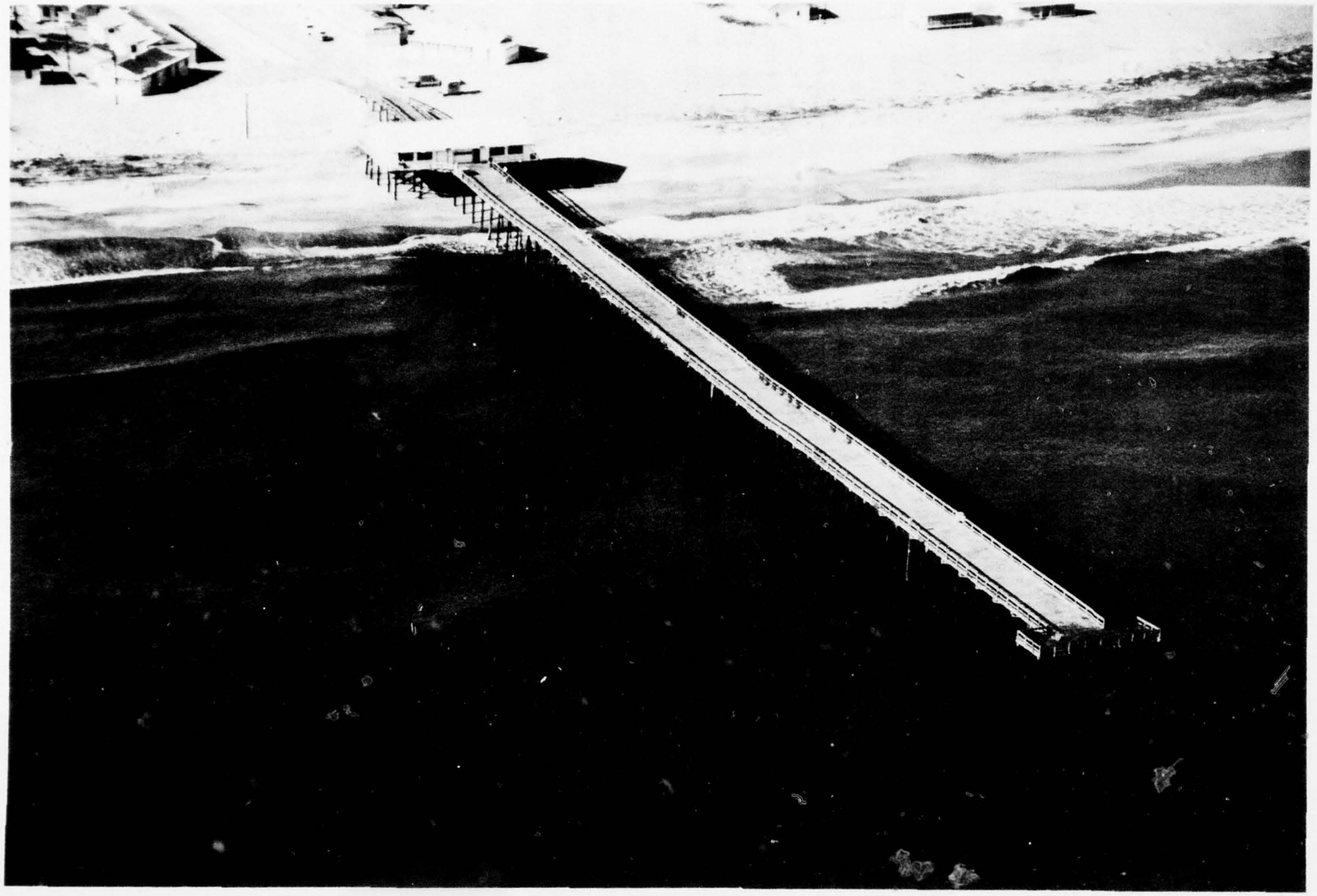

Figure 1. Jennette's Pier, Nags Head, North Carolina

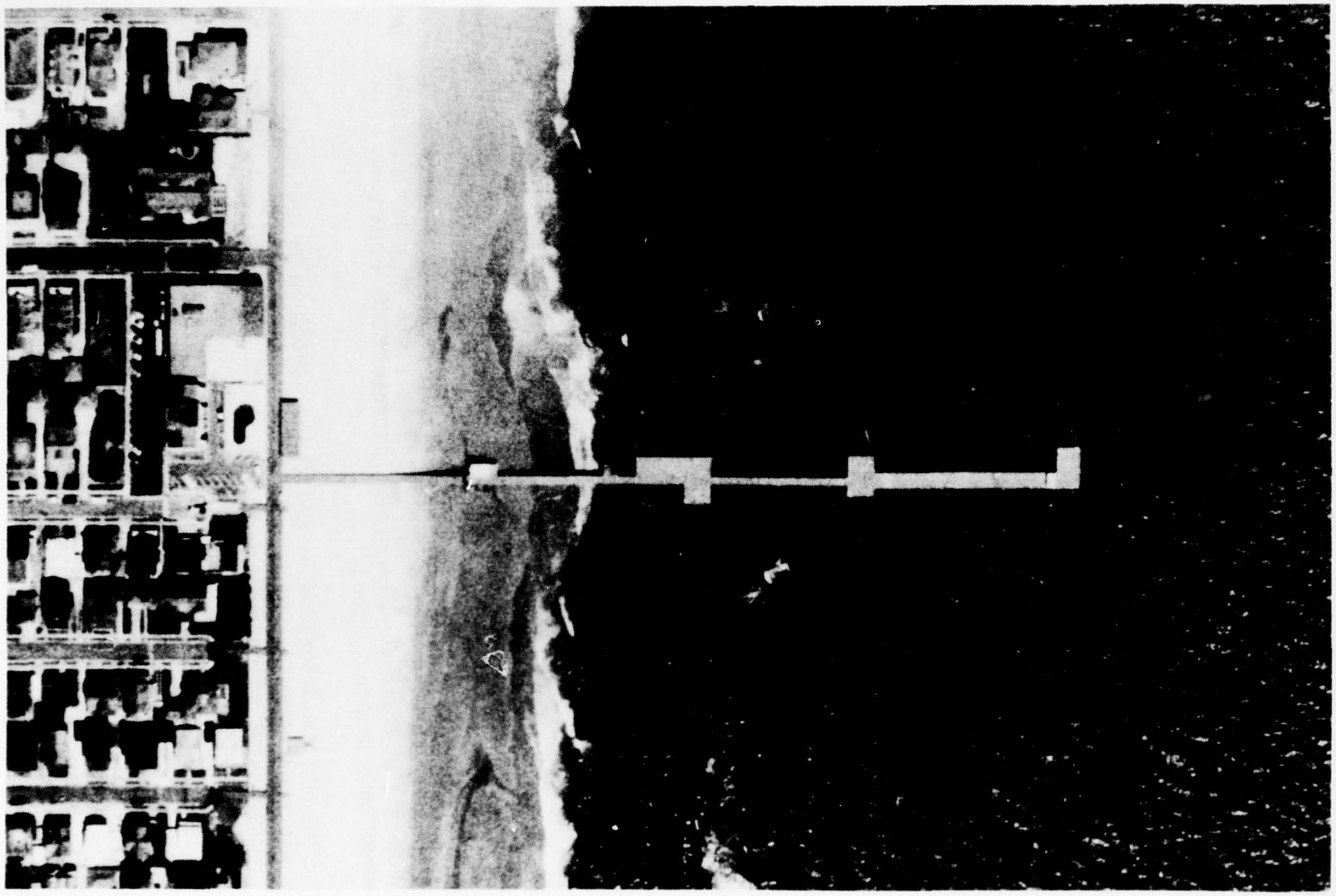

Figure 2. City Pier, Ventnor, New Jersey (14 May 1965).

is about 1,010 feet (308 meters) and the deck elevation varies from about 13 feet (4.0 meters) above MWL at station 22 to 24 feet (7.3 meters) above MWL at station 1010.

Beach and nearshore profiles from the beginning and end of the two data collections are shown in Figures 3 and 4. The profiles for both localities indicate that during data collection, there was relatively little sand movement on the major longshore bar and the beach accreted.

The profile data for Jennette's Pier were obtained from profiles made by Louisiana State University (LSU) Coastal Studies Institute, Baton Rouge, Louisiana (Dolan, Ferm, and McArthur, 1969). The profile data from City Pier were obtained by lead-line soundings from surveyed elevations on the pier deck. Local water depths were obtained from tide tables (U.S. Coast and Geodetic Survey, 1963, 1964) for Jennette's Pier and from a tide prediction program at the Coastal Engineering Research Center (CERC) for the Steel Pier at Atlantic City, which is 3 miles northeast of City Pier. Depth data, profile data, and tide data are included in Appendixes A, B, and C, respectively.

2. Pump Sampler.

Pump-sampling systems have a long history of use in river sampling (U.S. Inter-Agency Committee on Water Resources, 1941, 1952, 1962; Witzigman, 1963).

The pump sampler used in the littoral zone to obtain the data in this report is described by Fairchild (1965). The basic instrument consists of an intake nozzle (0.5-inch (1.27 centimeters) inside diameter) on a boom-mounted telescoping support pipe, a pump, and a settling tank (Fig. 5). Sediment suspensions are collected by placing the intake nozzle in the water and continuously pumping out (for about 3 minutes) a water-sediment mixture. This mixture is decanted and weighed to produce a suspended-sediment concentration. For field use, the system is mounted on a tractor and is designed to be operated from fishing piers or other platforms less than 20 feet above water. The field instrument has also been used in CERC's large wave tank (Monroe, 1966).

The pump system described by Fairchild (1965) is an outgrowth of laboratory experiments in measuring suspended sediments (Watts, 1953; Fairchild, 1956). More recent efforts in measuring wave-induced suspended-sediment concentrations have emphasized electronic instruments (Brenninkmeyer, 1975; Locher, Glover, and Nakato, 1976).

a. Nozzle Orientation. Nozzle orientation is important in the operation of the pump sampler in a wave-induced oscillating flow. If the nozzle axis is horizontal and parallel with the direction of wave travel, the axis is pointed into the flow part of the time and with the flow the remainder of the time. If the axis is not horizontal, the sample is drawn from elevations above or below the nozzle mouth, depending on whether the axis is pointed up or down. The nozzle orientation with the least apparent

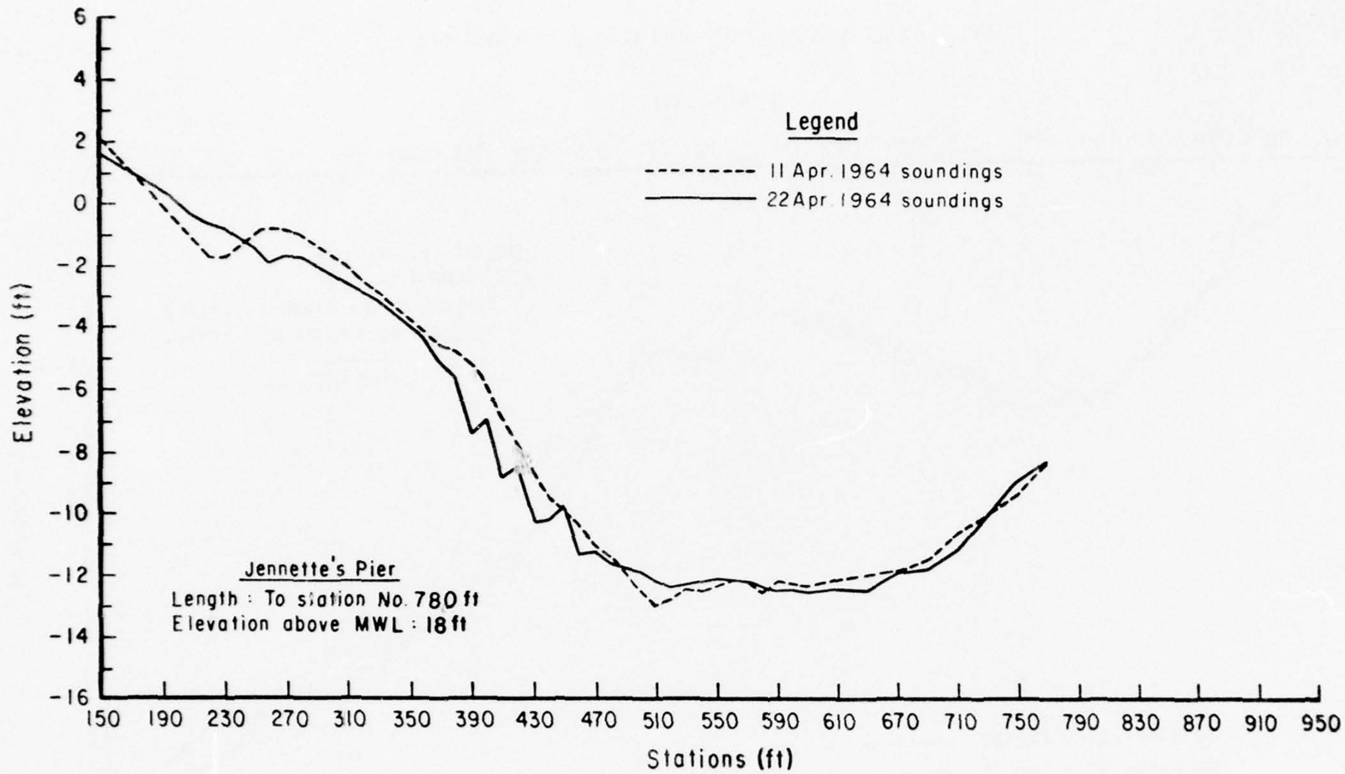

Figure 3. Profiles at Jennette's Pier.

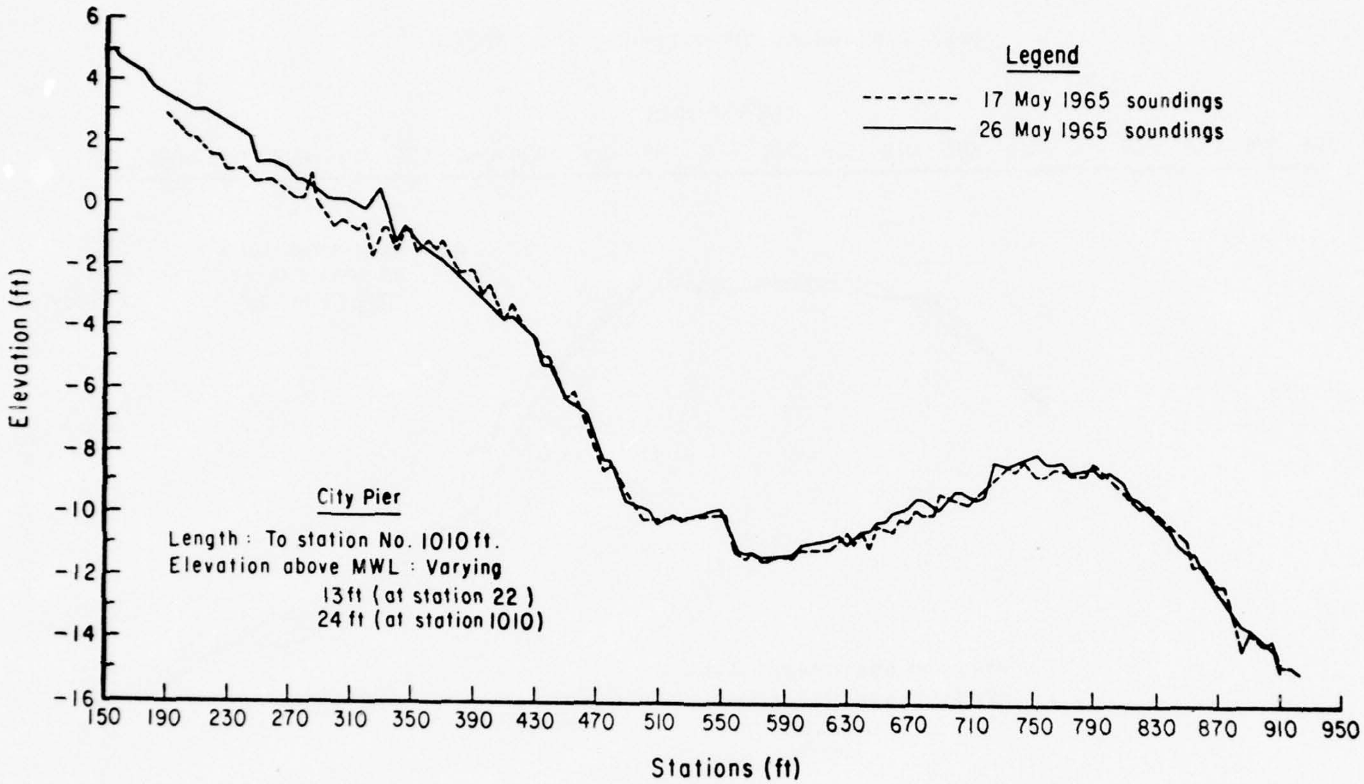

Figure 4. Profiles at Ventnor City Pier.

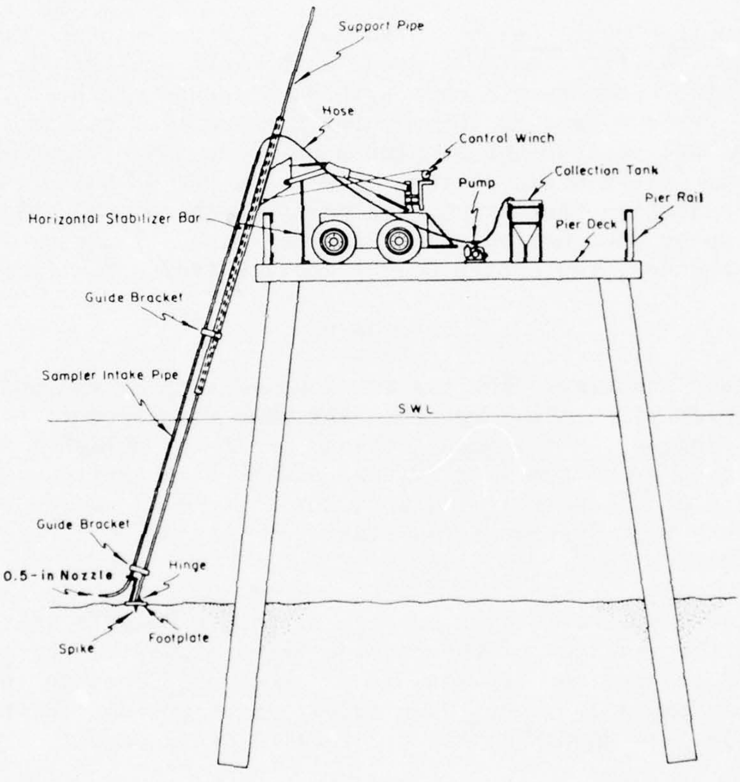

Figure 5. Tractor-mounted, suspended-sand sampler in operation on pier.

bias is when the nozzle axis is horizontal and parallel with the wave crest. For the sampling equipment used in these tests, the nozzle was oriented approximately perpendicular to the pier axis, which was usually within 10° of the wave crest although it may have been as much as 20° to 25° away from parallelism with short-period wave crests. The nozzle is approximately horizontal when the boom is at a standard angle of approximately 15° with the vertical. Deviations from the horizontal position during the tests were slight, and are considered unimportant.

b. Measuring Nozzle Height. Two methods for measuring nozzle height were devised. The first method, used in the Nags Head sample collection, consisted of two measurements made with each change of the nozzle height. This method involved reading the sampler pipe angle, θ, and measuring the displacement, R, of the sampler pipe above its minimum level when the nozzle was at the ocean bottom. The value of R was determined indirectly by scaling the motion of a point on the winch cable which controlled the up or down motion of the sampler pipe. Therefore, in the Nags Head samplings, the nozzle height above bottom, E, is given by:

$$E = R \cos \theta \quad . \tag{2}$$

For the Ventnor samplings, the tractor-mounted sampler was modified by adding a sampler pipe stop (Fig. 6). The stop was added to prevent the nozzle from clogging in the ocean bottom, and to establish a fixed initial nozzle height above bottom [the initial nozzle height with $\theta = 13.4°$ was 0.25 foot (7.6 centimeters)]. As an aid in obtaining nozzle elevation quickly, graphs were developed to relate the initial nozzle height to θ, and then to determine E from θ and R.

Samples were collected over a range of nozzle heights above the bottom to determine the gradient of the concentration above the sediment bed. Values of E ranged from the minimum of about 0.25 foot to the middepth level which averaged 2.5 feet (0.76 meter) above bottom. Vertical spacing between samples was approximately 0.2 foot (6 centimeters).

3. Sand Ripple Effects.

In addition to the vertical variation of suspended-sediment concentration, the concentration also varies in space and time because suspended particles boil upward in clouds of particles when wave crests pass over the sand ripple crests (Fairchild, 1959; Kennedy and Locher, 1972). As observed in wave tanks, sources of the particle clouds appear to be randomly spaced along the ripple crest, but whether these source locations are purely random or not is not known. The following hypothesis offers one explanation for these observations. Random locations of particle clouds may result from flow separation and "continuity" effects imposed across the flow by the upstream rippled bottom. In this way, constriction of the near-bottom flow into zones of low ripple height may explain why particle clouds are sometimes lifted above segments of ripple crests which appear smoother than adjacent irregular segments. Those particles immediately below the local maximum velocity in these constricted zones would be the first to be

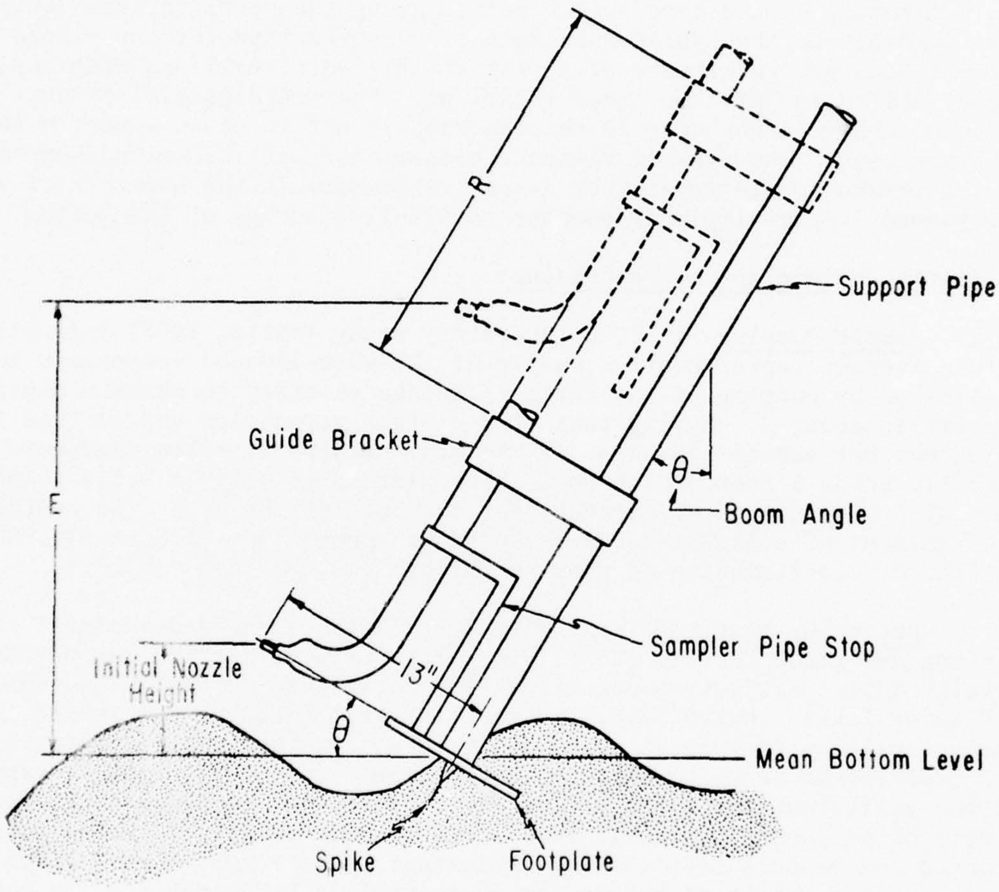

Figure 6. Footplate and intake nozzle in operation.

suspended; adjacent particles would become suspended later with further increase in orbital velocity as the wave crest nears coincidence with the sand ripple crest. At this point the particle clouds boil upward rapidly, move slightly ahead of the sand ripple crest, then reverse direction as particles settle in the slower velocities under the wave trough. Ripple observations show that particle clouds occur for sustained times (greater than 5 minutes) at the same source points along the ripple crests, which lends evidence to the hypothesis since time is required for the ripple system to change, and thence give rise to shifted streamlines with consequent shifts in particle cloud locations. Suspended-particle clouds have been observed not only in the laboratory, but in ocean waves in the nearshore zone. The varying distance between the particle cloud sources and the intake nozzle apparently causes randomness in the quantity of sediment pumped, especially when pumping is within 6 inches of the bottom.

4. Sample Collection and Processing.

a. Sample Pumping. A CERC laboratory study (Watts, 1953) indicated that an average representative sample of the wave-induced suspension could be obtained by pumping if the ratio of intake velocity to maximum orbital velocity is about 2. During this study, intake velocities varied from 18 to 25 feet per second (see App. A) and maximum orbital velocities were generally below 5 feet per second, so the intake velocity-orbital velocity ratio of 2 was equaled or exceeded for the bulk of the data. An average of 40 gallons of sediment-laden seawater was pumped for each sample, which required 2.5 to 3 minutes of pumping through the 0.5-inch nozzle.

b. Decanting Water-Sediment Mixture. In the suspended-sediment collections described in this study, the water-sediment mixture was pumped directly into a collection-decanting tank calibrated for volume versus tank water level. Water levels in the tank were taken on completion of pumping, using a Lory point gage, and recorded on the sampling data sheet. The total volume in each sampling was obtained from a calibration graph, and the equivalent saltwater weight for this volume was based on a specific gravity of 64 pounds per cubic foot. The ovendry weight of the sediment, decanted and reduced from the water-sediment mixture, was then divided into the total weight to obtain the concentration by weight for the sampling.

Partial separation of the sediment from the pumped water-sediment mixture was accomplished in the field, using the sediment extraction mechanisms shown in Figure 7. For the Nags Head data collection, most of the samples were decanted with tank 2; for the Ventnor data, most were done with tank 3. In using any of the decanting mechanisms, 5 minutes was allowed for sediment to settle after the sample pumping had ceased. The methods used to decant the water from the sediment in tanks 1, 2, and 3 were as follows:

(a) In tank 1, the sand which had settled out at the bottom of a transparent plastic hose loop (Fig. 7) was flushed out by lowering the discharge end of the hose below the elevation of the

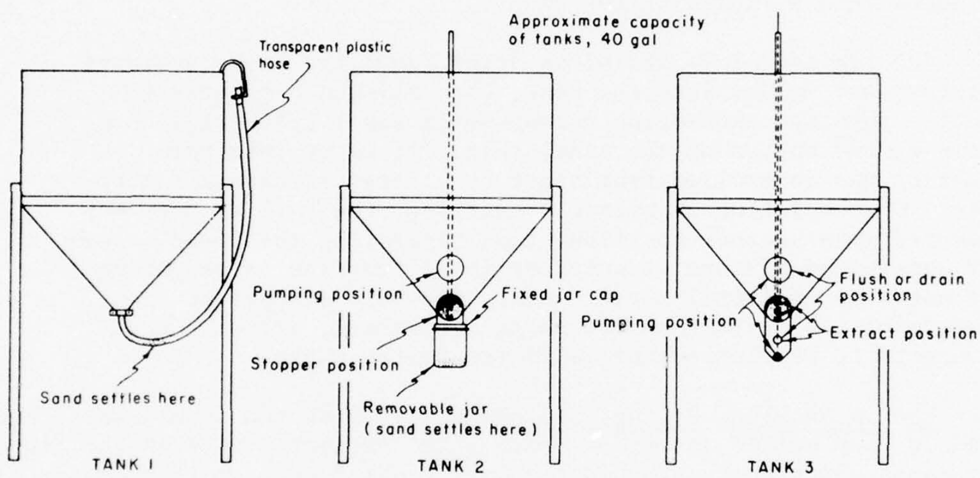

Figure 7. Three collection-decanting tanks.

water level in the tank. A thumb held over the hose discharge while directing it into a fluted (cupped) filter paper was removed just long enough for the sand and water to be flushed out and into the paper.

(b) In tank 2, sample pumping proceeded with a large rubber ball in an upper position as shown in Figure 7. After sediment settling, the ball was lowered into stopper position, thus isolating water-sediment volume in the glass jar below the ball stopper from the main settling tank volume. The thread-connected glass jar was then carefully removed and its contents poured and flushed into a fluted filter paper.

(c) In tank 3 (a stainless steel tank), the water sediment mixture was pumped into the tank, then allowed 5 minutes to settle into the extraction mechanism (a small cylindrical section at the bottom of the tank) (Fig. 7); entry into this section was controlled from above by a large rubber ball stopper. On completion of particle settling, the ball stopper was lowered into stopper position, thus separating the lower volume of water-sand mixture (1 quart or less) from the large volume of water (40 gallons) above. Next, the ball stopper at the bottom of the extraction mechanism was raised, allowing the contents to be flushed into a fluted filter paper.

c. Sample Packing, Drying, and Weighing. When the excess water had drained in each method described above, the sediment sample in the fluted filter paper was placed in a plastic bag, identified by collection date and data sheet number, and returned to CERC for laboratory analysis. The samples were air-dried at room temperature with drying completed in a temperature-controlled oven. Dry samples were promptly weighed, in an attempt to assure a uniform moisture content at the time of weighing.

d. Settling Tube Analysis. A settling tube analysis (visual accumulation method) was made of usable samples weighing 2 grams or more. Seventeen of the 415 samples collected at Ventnor weighed less than 2 grams. The results were reduced to graphs of sediment-size distribution in both sets of data and excerpts from these are included in Appendix D.

5. Data Collected.

The concentration of suspended sediment caused by wave action in and near the surf zone depends on the wave and sediment characteristics, and position with respect to the bottom and the breaker line. The principal independent variables in this study (eq. 1) are the wave characteristics, the position of the sample, and some information on sediment size. The field data collected for each sample are indicated on a data sheet (Fig. 8). Data recorded on these sheets have been reduced and are tabulated in Appendix A for both the Ventnor and the Nags Head data collections. Other necessary data are in Appendixes B, C, and D which are compilations of bottom profiles, tide curves, and particle-size curves, respectively.

DATE: 17 May 65 SAMPLE # 101 BARREL # 3

TIME 10:10 LOCATION ON PIER Sta. 430

BOOM ANGLE 10½° NOZZLE SETTING ABOVE BOTTOM 1.48 ft

BARREL WATER LEVEL 1.983' PUMPING DURATION 2 MIN 25 SEC.

BREAKER LOCATION Sta. 340-350 (345 Center) TYPE Plunge + spill

BREAKER ANGLE ____ N 5° S HEIGHT 1.48 FT.

BREAKING DEPTH × FT. WATER TEMP. 56 °F

WATER DEPTH × FT. WAVE PERIOD 11 SEC.

WAVE HEIGHT 1.65 FT. TIDE LEVEL MSL +1.95 FT.

ELEV. OF BOTTOM AT SAMPLING PT. ×

WIND VEL. ____ WIND DIRECTION S.W.

REMARKS:

Sample wt. - 5.8 gr.

Vol. pumped - 5.10 cu. ft.

Conc. PPT - .039

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Figure 8. Suspended-sediment sample data sheet.

The most important characteristic of the sediment in suspension is fall velocity. In general, fall velocity depends on size, shape, specific gravity, and water viscosity. Since most of the sediment was rounded quartz sand grains, the shape and specific gravity do not significantly vary, so the most important sediment characteristic is size. To initiate transport of a sediment particle, local water velocities must exceed the threshold velocity of the given particle size. The threshold velocity for the range of particles sizes reported for the Ventnor data (0.12 to 0.15 millimeter, median diameter) is about 0.8 foot per second (Rance and Warren, 1968; Komar and Miller, 1973; U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975). Considering the range of wave periods and heights reported here as 5 to 10 seconds and up to 4 feet in height, maximum horizontal velocities up to 8 feet per second (more than 10 times threshold velocity) may be expected before the waves break in a 5.5-foot water depth (Inman, 1956).

6. Wave Data.

In the Ventnor data, significant wave heights and periods were reduced from strip-chart recordings obtained from a wave gage system. The system consisted of a pressure transducer, recorder, amplifier, and about 800 feet (244 meters) of a two-wire cable. The pressure transducer was anchored near the bottom, off the end of the pier at station 1014 in a 15-foot (4.6 meters) water depth. This station was about 600 feet (183 meters) seaward of the midrange of the sampling stations where water depths averaged only 2 to 5 feet (0.6 to 1.5 meters). The wave gage system produced a strip-chart recording of the wave characteristics during each sample collection, except during the last 2 days of the fieldwork when the recorder failed. Visual estimates of wave breaker height were then made on a spot-check basis.

In the Nags Head data, wave records were obtained from a CERC staff gage located on Jennette's Pier. The gage produced 20-minute programed recordings on a paper strip chart and continuous recordings on magnetic tape. The magnetic-tape records were analyzed by the CERC wave spectrum analyzer which gives a wave energy spectrum over a range of wave periods, a linear average, a square average, and peak wave heights. The significant wave height, H_s, was obtained from the peak wave height, using the formula, $SH_c/PH_a = 0.67$, where SH_c is the significant height on a paper strip-chart recording and PH_a is the peak height from the analysis by the spectrum analyzer of the magnetic-tape record. Values of significant wave height thus obtained for Nags Head are compiled in Appendix A.

III. DATA ANALYSIS

This section discusses the suspended-sediment concentrations obtained from the piers at Nags Head and Ventnor. The approach is empirical, and aims at separating relations between the independent variables of equation (1) and the dependent variable, concentration, using data in Appendixes A to D. The discussion includes sediment-size data, the relation between concentration and the position of the sample, the relation between concentration and the wave conditions, and causes of observed scatter.

1. Concentration.

Figure 9 shows the distribution of suspended-sediment concentration (in parts per thousand) for this study. The median concentration of all samples is about 0.15 parts per thousand for Nags Head and slightly greater for Ventnor. The maximum measured concentration reached 4 parts per thousand in the Nags Head samples and 2.6 parts per thousand in the Ventnor samples. Some of the extreme Nags Head samples were possibly due to the nozzle being without the footplate (Fig. 6) during that part of the study. Without the footplate the nozzle may have been closer to the bottom at times and sucked more sediment.

2. Sediment Size.

Sediment-size data are summarized in the table, in Figures 10, 11, and 12, and in Appendix D. These data indicate that the median size of suspended-sediment samples was typically about 0.13 millimeter at Ventnor and about 0.18 millimeter at Nags Head. Contemporary beach samples at Ventnor had a median size of about 0.20 millimeter (App. D, Fig. D-4); contemporary bottom samples at Nags Head were between 0.23 and 0.35 millimeter at stations where suspended-sediment size was only about 0.16 to 0.22 millimeter (see Table). Because no bottom samples were collected contemporaneously with the suspended sediments at Ventnor in 1965, a few bottom and suspended-sediment samples were collected later in March 1971 at that locality (Schweppe, 1971). Bottom samples at Nags Head were collected by a grab sampler operated from the pier deck, and at Ventnor by a diver scooping sand into a plastic sample bucket.

The table compares the median size of bottom and suspended-sediment samples. The median size of bottom or beach sediments is, in all cases, greater than the median size of the suspended sediment at that time. For the data shown, the median size of bottom samples at Nags Head was about 63 percent greater than the suspended samples; the median size of the beach samples in May 1965 at Ventnor was about 54 percent greater than the size of the suspended samples. However, the few data from Ventnor in March 1971 indicate a percent difference of only 22 percent, apparently because the suspended-sediment samples were much coarser in March 1971 than in May 1965. The reason for this is not known, but possible explanations include effects of depth changes, water temperature, or wave conditions (Schweppe, 1971).

The circles in Figures 10, 11, and 12, show that coarser sediment does get suspended, and the coarsest 5 percent of the sample is often more than twice the median size in millimeter. Also, these data show surprisingly little variation in median size with increase in water depth (Fig. 10), nozzle elevation (Fig. 11), or distance from the breaker (Fig. 12). There does appear to be a slight tendency for size to decrease with increasing water depth and nozzle elevations.

One restriction on attempting to establish relations between the median size of the suspended sediment and the other independent variables of equation (1) is that median-size variation in the available sand is usually

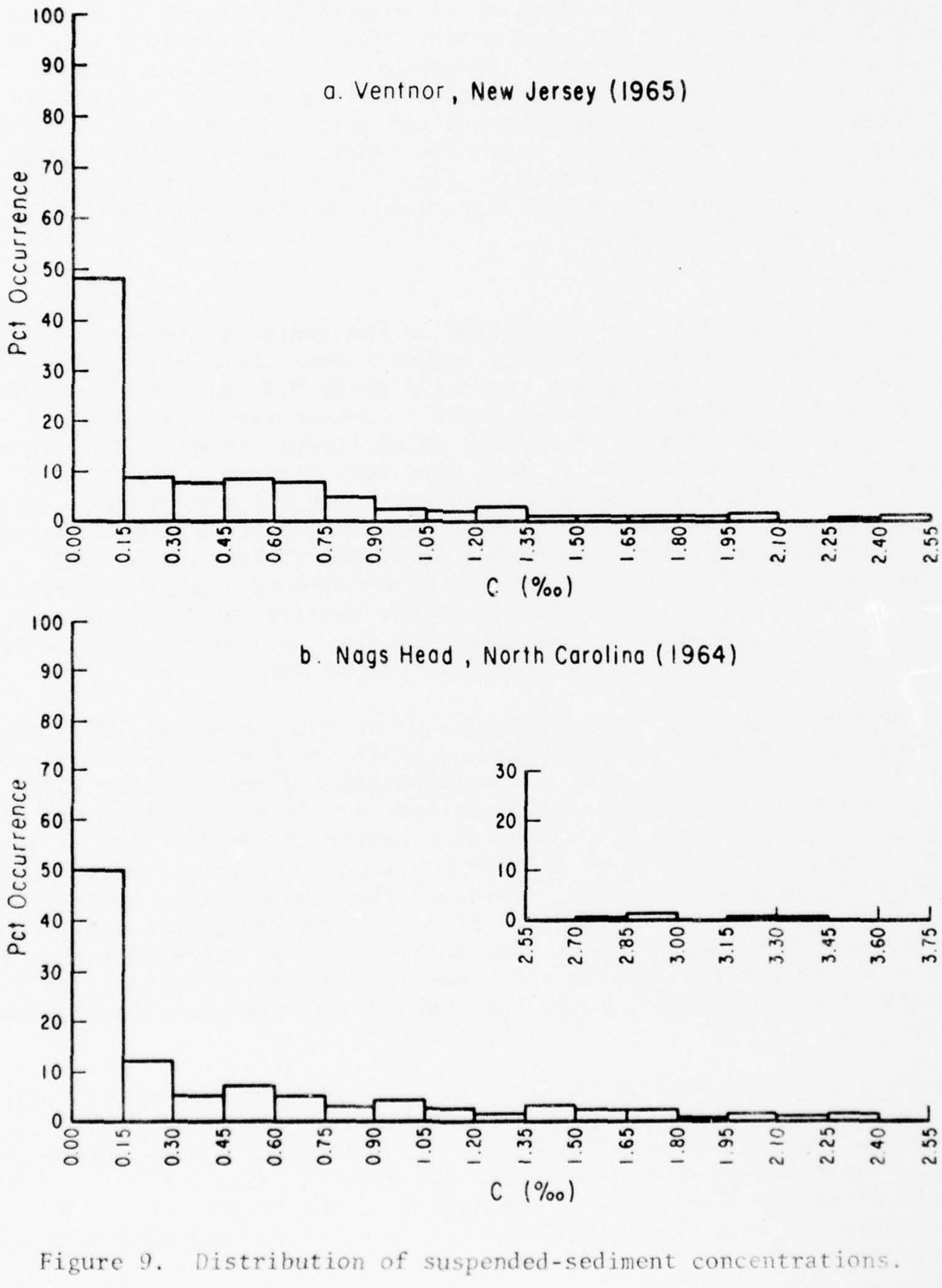


Figure 9. Distribution of suspended-sediment concentrations.

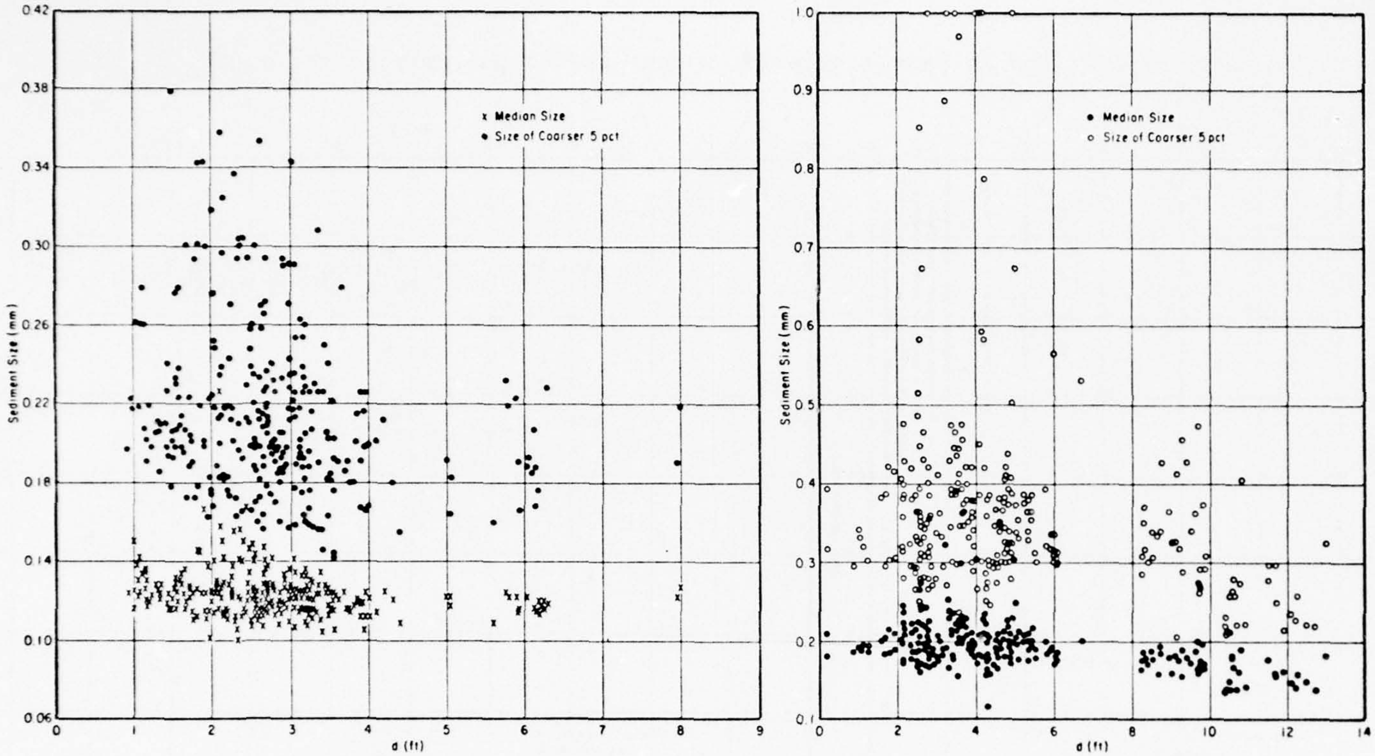


Figure 10. Median and coarse sand sizes distributed by water depth.

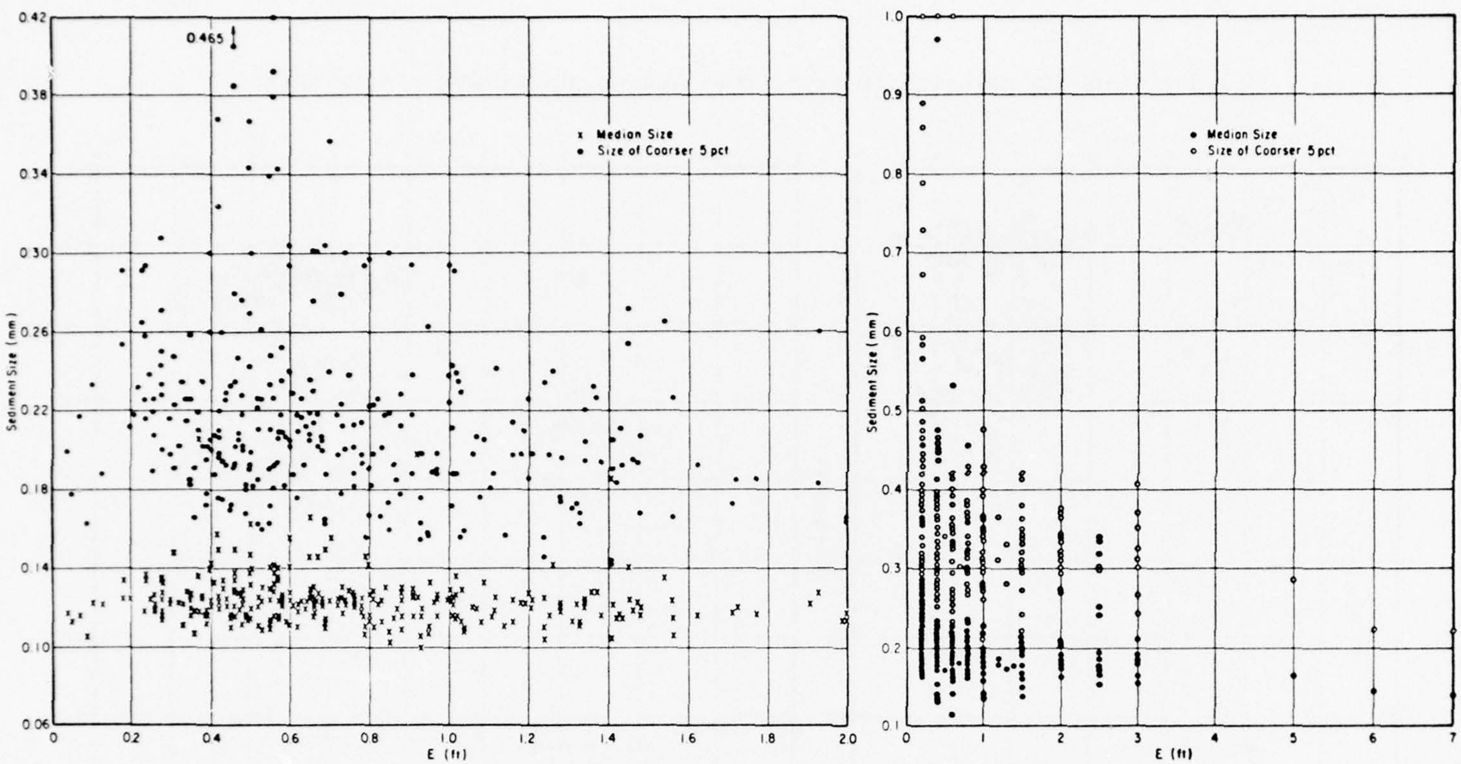


Figure 11. Median and coarse sand sizes distributed by nozzle elevation.

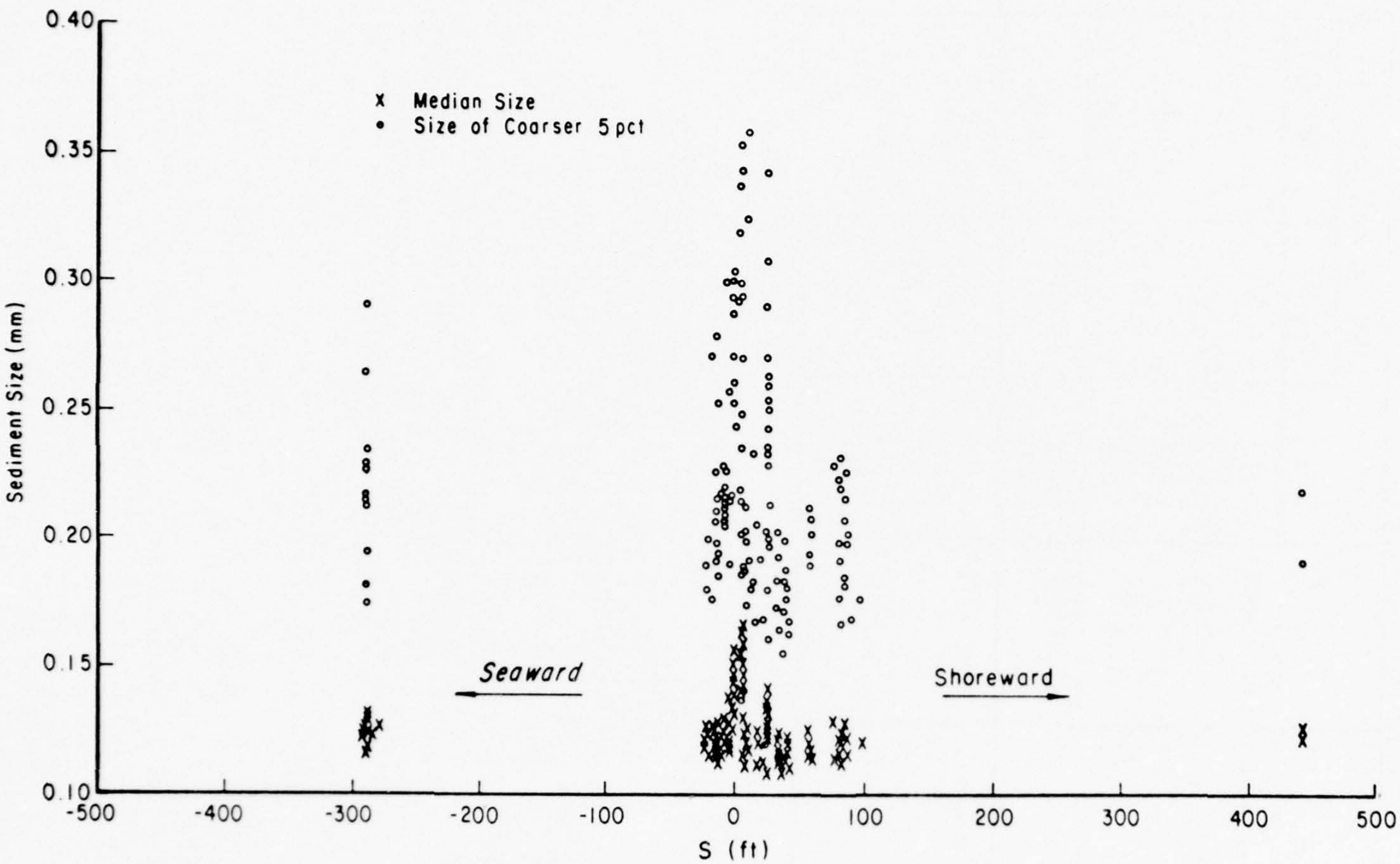


Figure 12. Median and coarse sand sizes distributed by distance from breaker position.

Table. Size difference between suspended and bottom samples.

Locality	Date	Station	Median sand size (mm)	
			Bottom	Suspended
Nags Head	Apr. 1964	320	0.30	
		285		0.22
		350	0.35	
		352		0.16
		765	0.23	
		758		0.16
Ventnor	May 1965	Beach	0.20	
		Typical		0.13
Ventnor	Mar. 1971	360	0.22	
		370		0.18
		375	0.22	
		375		0.19
		385	0.22	
		388		0.18

small. Most of the sand is so well sorted that the variation among samples may be less than the error inherent in sampling and determining the size data.

3. Sample Position.

Three of the independent variables in equation (1) describe the sample position--S is the horizontal location with respect to the defined breaker position, d is the local water depth, and E is the nozzle elevation above the bottom. Figures 13, 14, and 15 show the measured distribution of these variables in histogram form.

Individual waves in a series of waves approaching shore may break at different locations, rather than at a single point. For the Ventnor data, stations defining either end of the range of breaker positions were determined and the midstation within the range was defined as the breaker position. Figure 13 shows the distribution of samples relative to the breaker position. These data indicate that about 67 percent of the Ventnor data were collected within 25 feet of the breaker zero and only 11 percent were more than 50 feet from the breaker zero. About 45 percent of the sample locations were shoreward of the breaker zero and 55 percent were seaward. Since the waves were often small, and consequently the surf zone was shallow, there was a tendency to collect data from the seaward locations.

Figure 14 indicates the range of water depths during sampling at the two piers. By comparing the profiles shown on Figures 3 and 4, it was possible to sample at greater depths from Jennette's Pier than from City Pier. The profiles show depths of about 12 feet extended 150 feet along Jennette's Pier, landward of the major longshore bar, but at Ventnor it was necessary to get seaward of the major bar before reaching 12-foot depths. Although the extreme depths were greater at Nags Head, the most commonly sampled depths were greater at Ventnor (Fig. 14).

Figure 15 indicates the range of nozzle elevations. At both piers, the most common nozzle elevation was in the range 0.3 to 0.6 foot off the bottom, and nearly half of the samples were within 0.6 foot of the bottom. Some of the extreme Nags Head elevations were more than 10 feet above bottom.

Distance from the breaker position, S, is very important. Lacking any other information, it is assumed that sediment concentration will increase at and shoreward of the breaker position, as compared to the concentration seaward of the breaker. Figure 16 supports this assumption, using data from Appendix A. The increase in sediment concentration can be up to two orders of magnitude, as shown by these data, and the concentration increases significantly with closeness to the bottom. Data to be presented later show that breaker type also affects concentration for given values of S.

Water depth is only incidentally related to suspended-sediment concentration in that depth controls breaking wave height and maximum possible

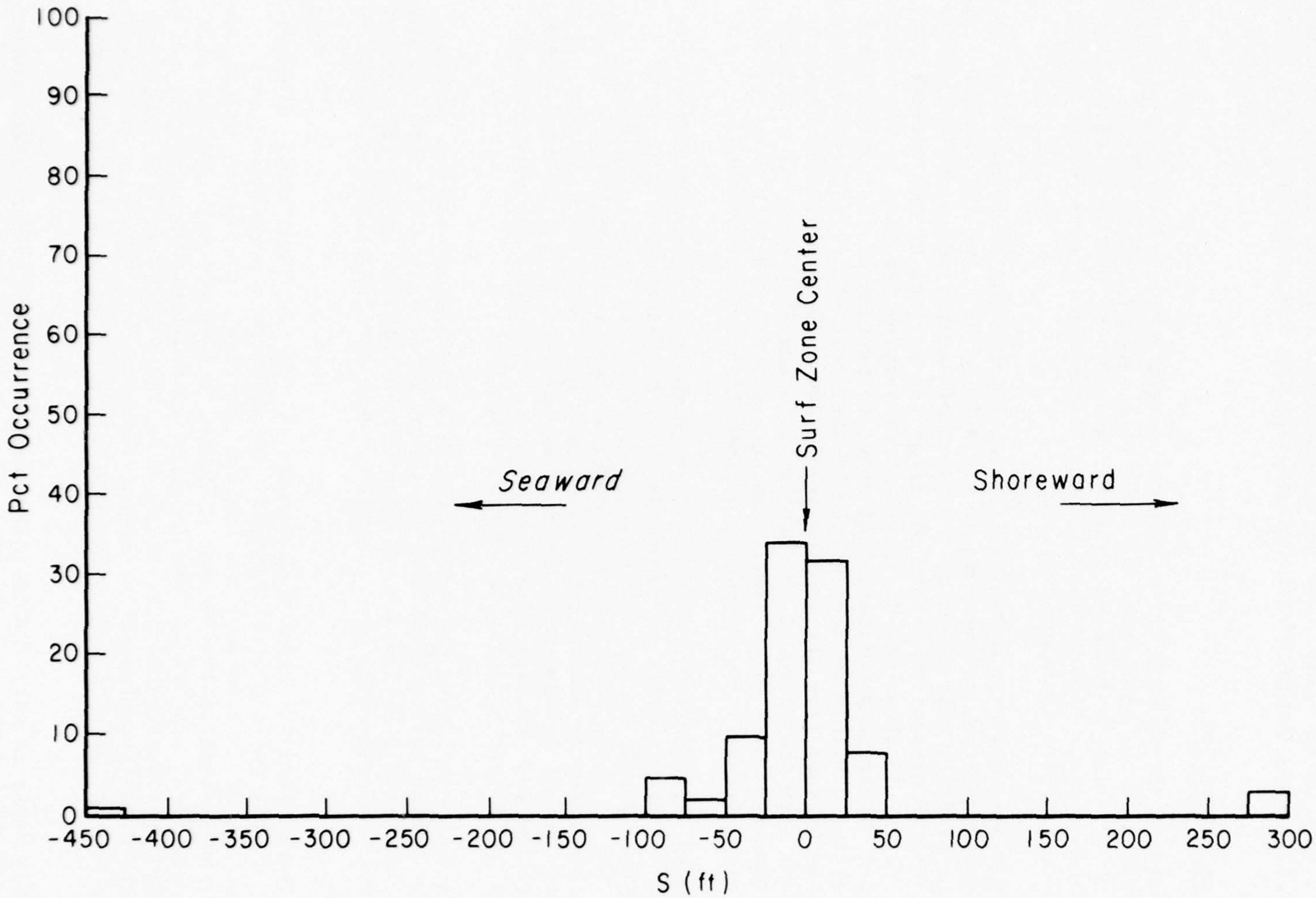
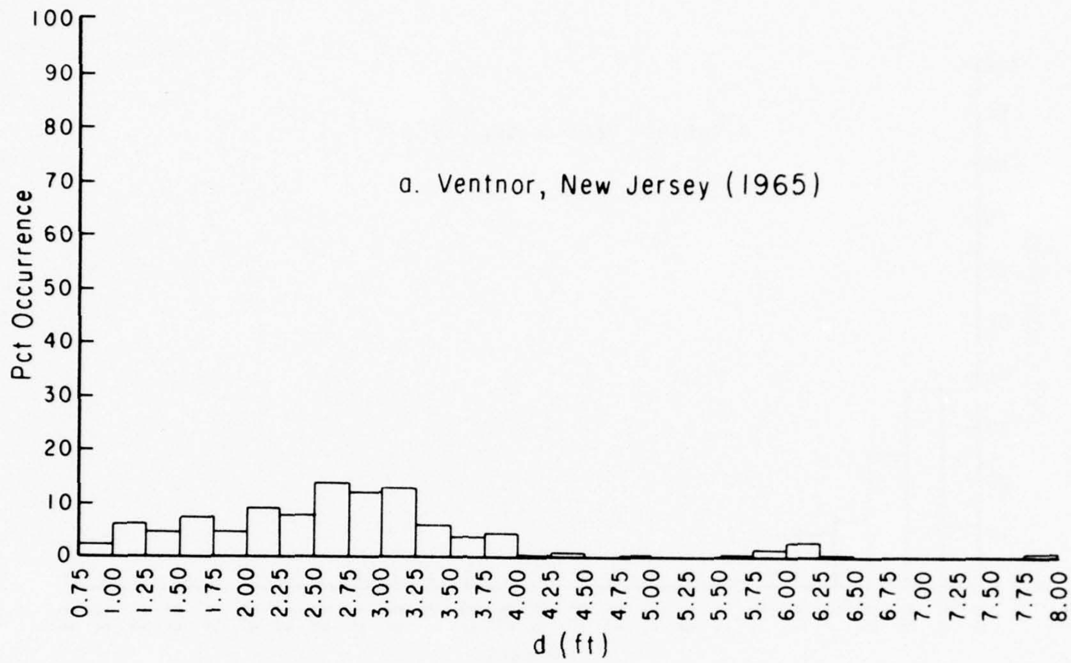


Figure 13. Distribution of sampling positions, relative to breaker position.



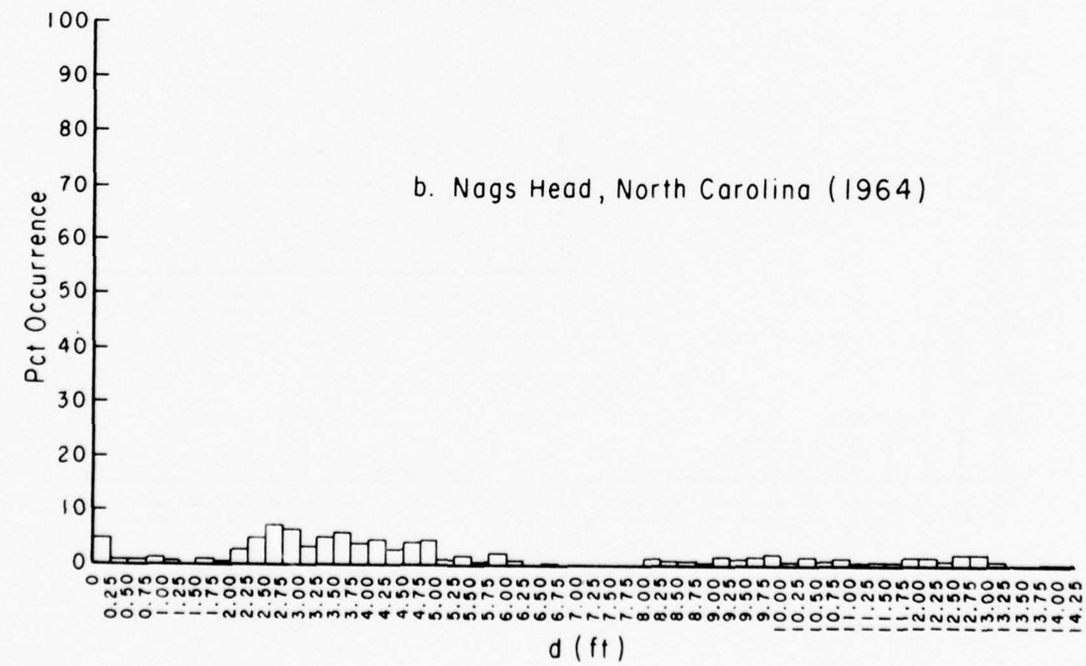


Figure 14. Distribution of water depths at sampling positions.

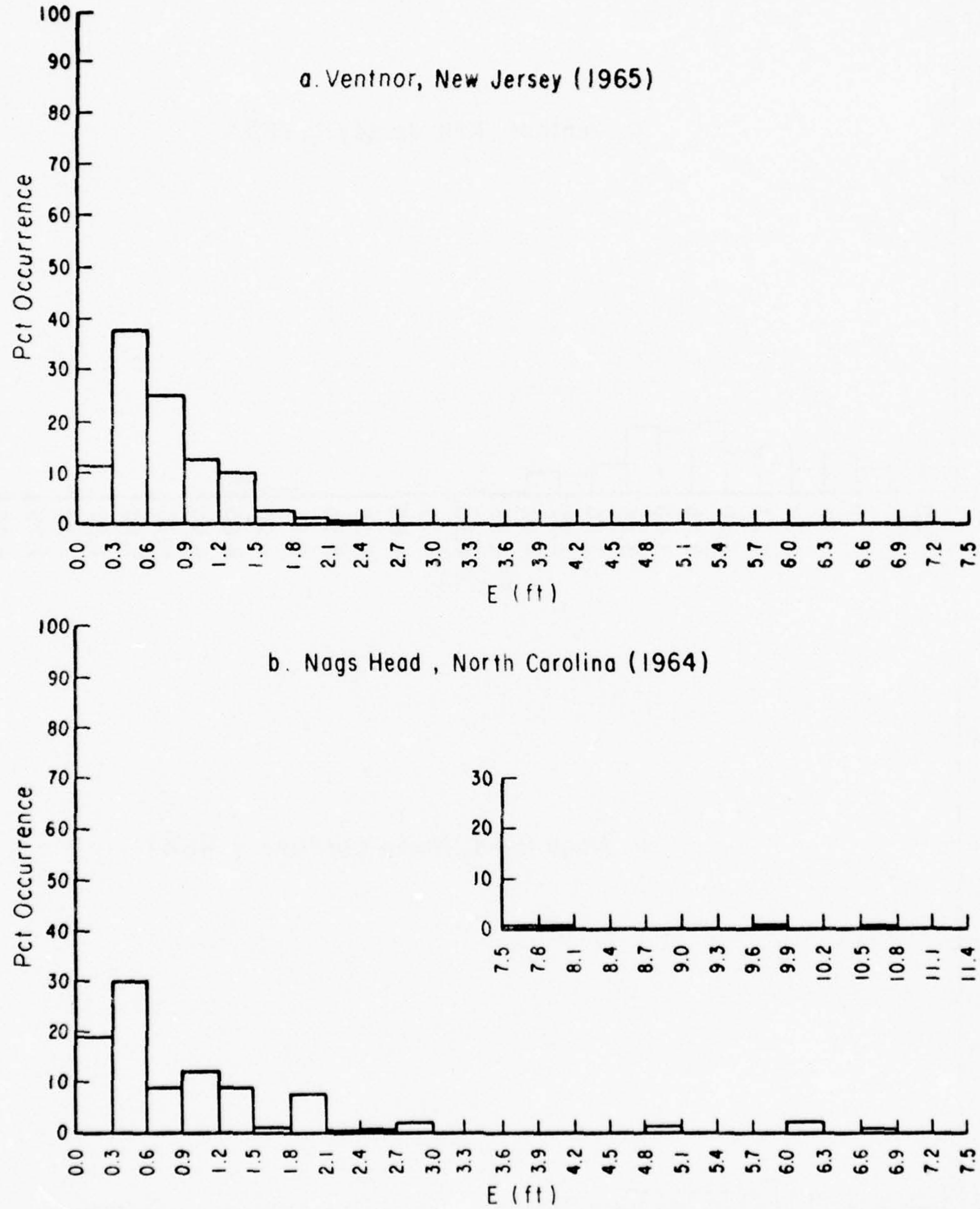


Figure 15. Distribution of nozzle elevations.

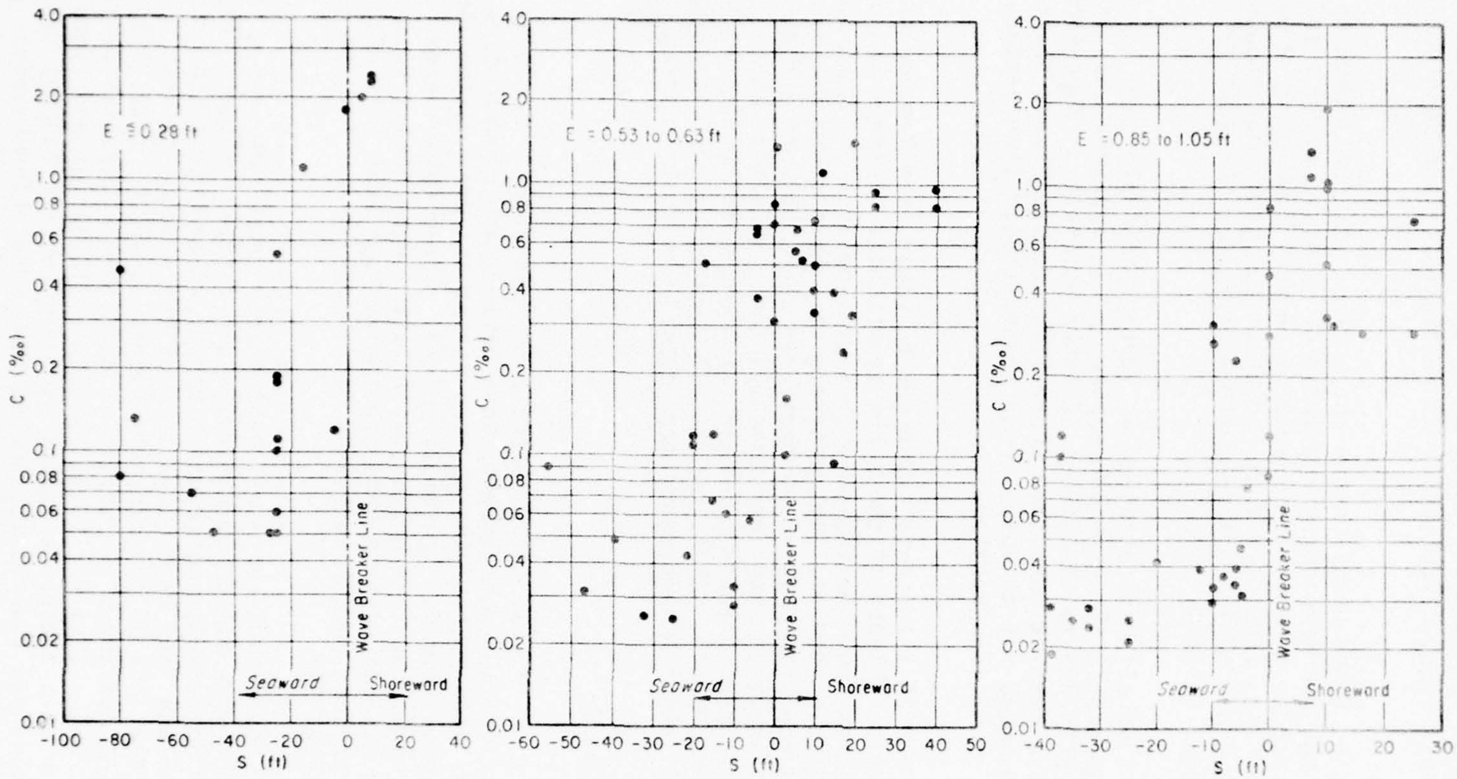


Figure 16. Shoreward increase in concentration across the breaker position (stratified in three ranges of nozzle elevation).

nozzle elevations. In general, there is no direct correlation between depth and concentration, a fact which is indicated by the data on Figure 17.

The elevation of the nozzle above the bottom, E, will have an important effect on the measured concentration, C. This is evident in Figure 16 where the concentration at the breaker line goes from about 2 parts per thousand for E less than 0.28 foot, to about 0.5 parts per thousand for E between 0.53 and 0.63 foot, to about 0.3 parts per thousand for E between 0.85 and 1.05 feet.

Figure 18 shows all data obtained at Ventnor in a plot of E versus C. The trend of increasing C with decreasing E is apparent, but the scatter is large, evidently due to the effect of other variables. Superimposed on Figure 18 are two sets of data from short-time intervals when these other variables are assumed not to vary. Over these shorter time periods, the expected trend shows less scatter.

Figures 19 and 20 illustrate C versus E plots from Ventnor and Nags Head, respectively. Figure 19 shows the logarithmic decrease in concentration with elevation above bottom which has previously been found in both laboratory and field studies. In comparing the three plots on Figure 19, the highest concentrations (C = 2.4 parts per thousand) are achieved in the one set of data where E was less than 0.4 foot. The fact that the linear relation on a log plot breaks down near the bottom has been noted in laboratory tests (MacDonald, 1977), and is illustrated by the data on Figure 20 which suggest that C increases more rapidly near the bottom.

4. Wave Conditions.

There are three variables of interest to this study describing the waves in the surf zone--wave height, wave period, and breaker type. The distribution of wave heights and periods during the data collection is shown in histogram form on Figures 21 and 22. These data suggest that the most commonly occurring wave height was a little more than 1 foot at both sites, but the extreme heights were greater at Nags Head (Fig. 21). The dominant wave periods were 5 to 8 seconds at Ventnor and 7 to 12 seconds at Nags Head (Fig. 22).

In general, suspended-sediment concentration does not vary greatly with wave height when all other variables are fairly constant. Figures 23 and 24 show no definite correlation between wave height and concentration at Ventnor and Nags Head. The lack of correlation between H_s and C is similar to the lack of correlation between d and C (Fig. 17). However, the ratio, H_s/d, of these two variables does have a positive correlation with C (Fig. 25). (See Fig. 8 in Fairchild (1973) for additional plots.) Possibly, H_s/d is a measure of sampling position with respect to the breaker position, and thus is related to the correlation between C and S (Fig. 16).

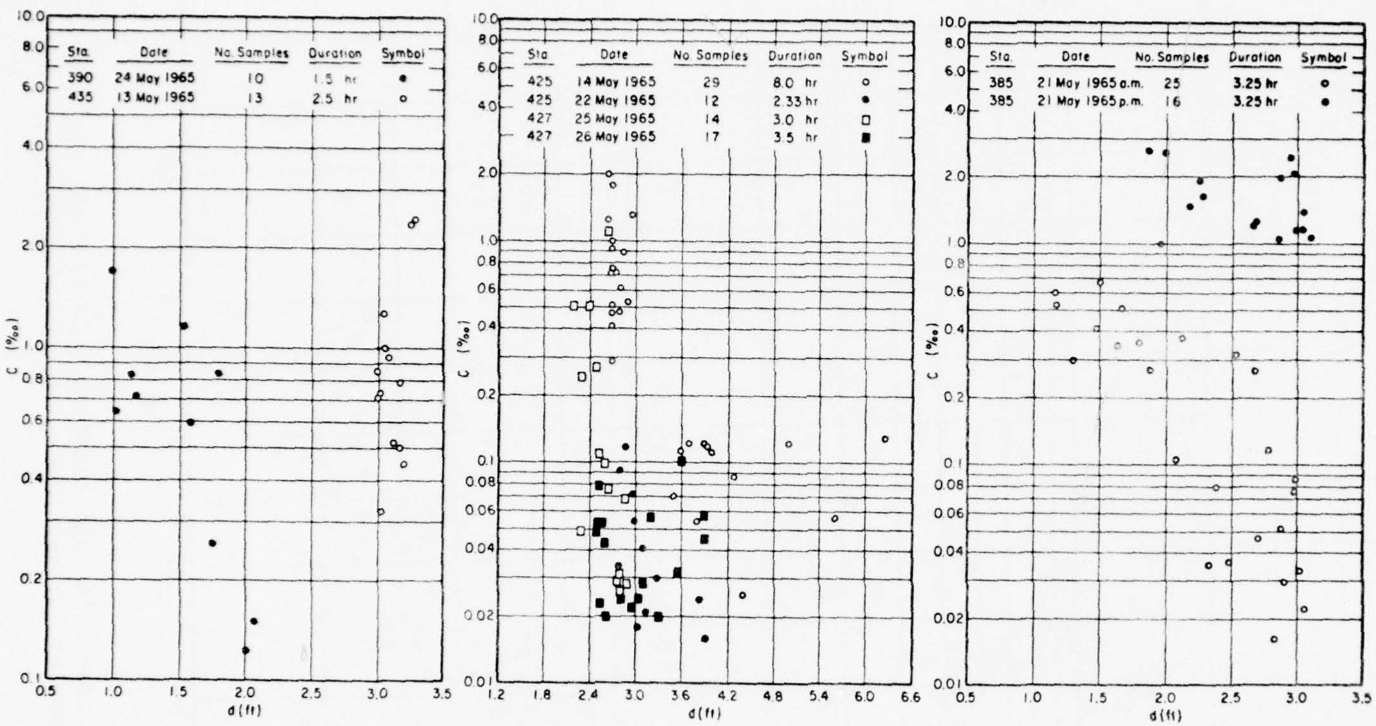


Figure 17. Lack of relation between concentration and local water depth.

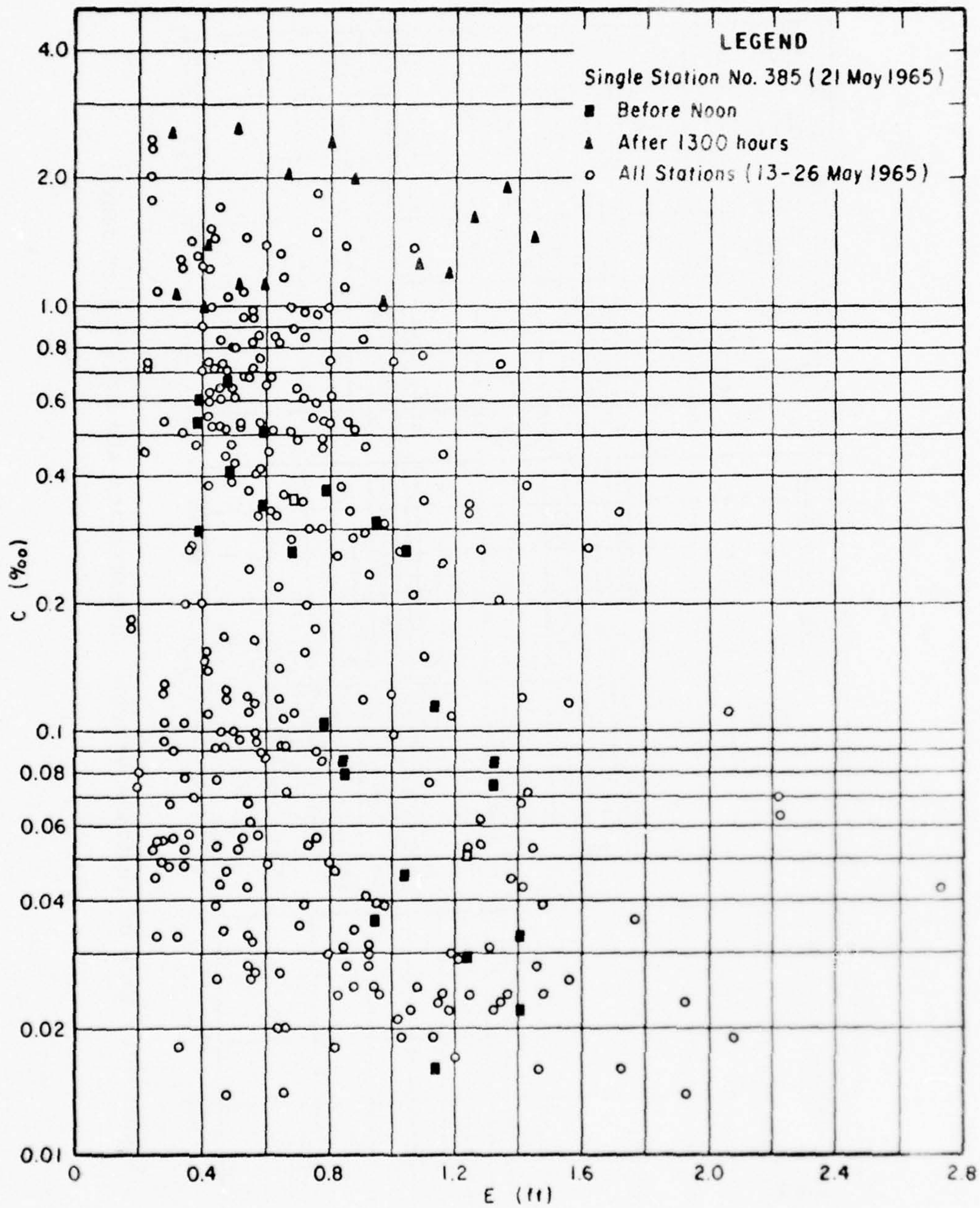


Figure 18. Decrease in concentration with elevation at Ventnor for all samples (21 May 1965 sample highlighted).

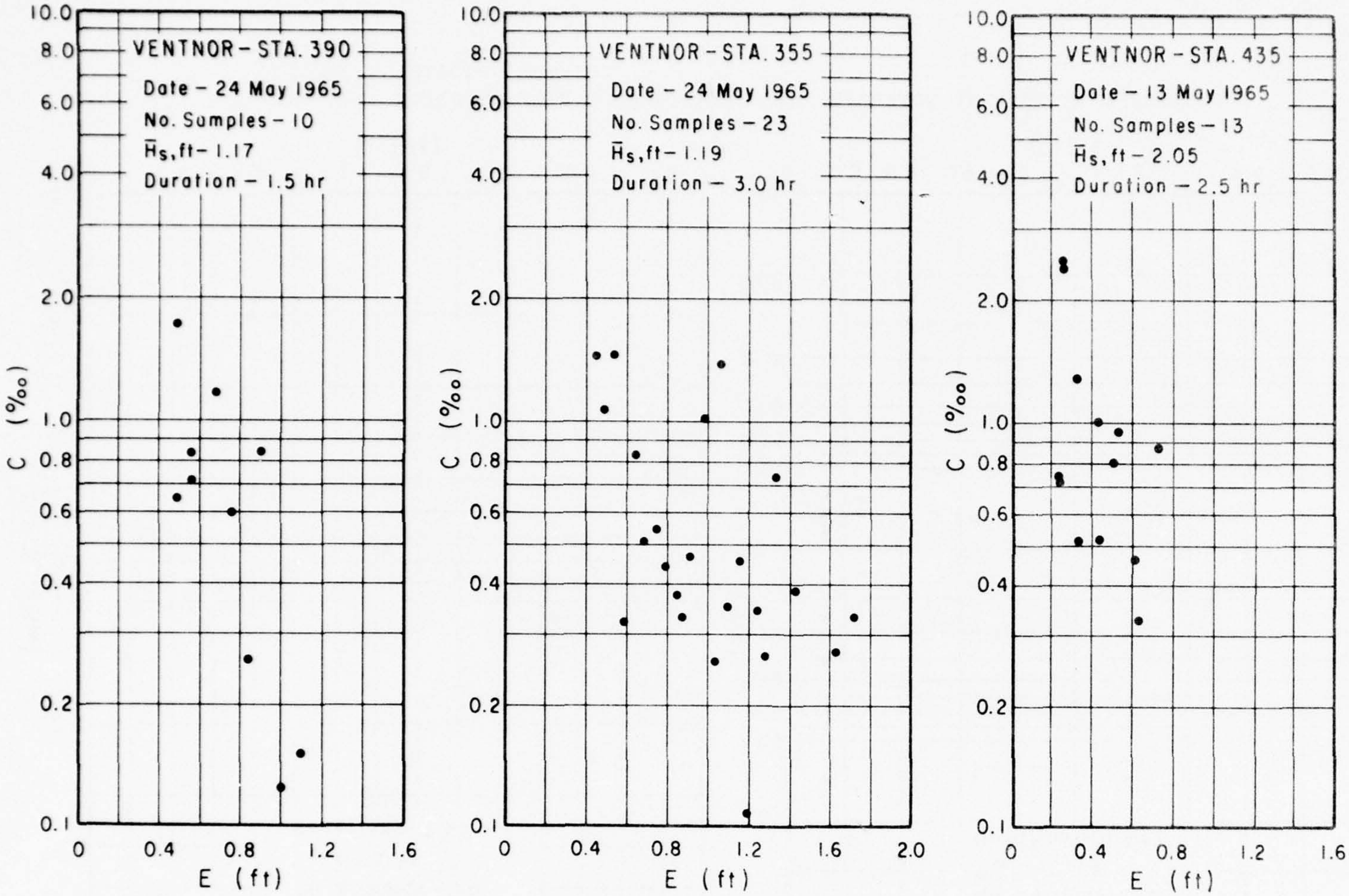


Figure 19. Decrease in concentration with elevation at Ventnor for three selected sample sets.

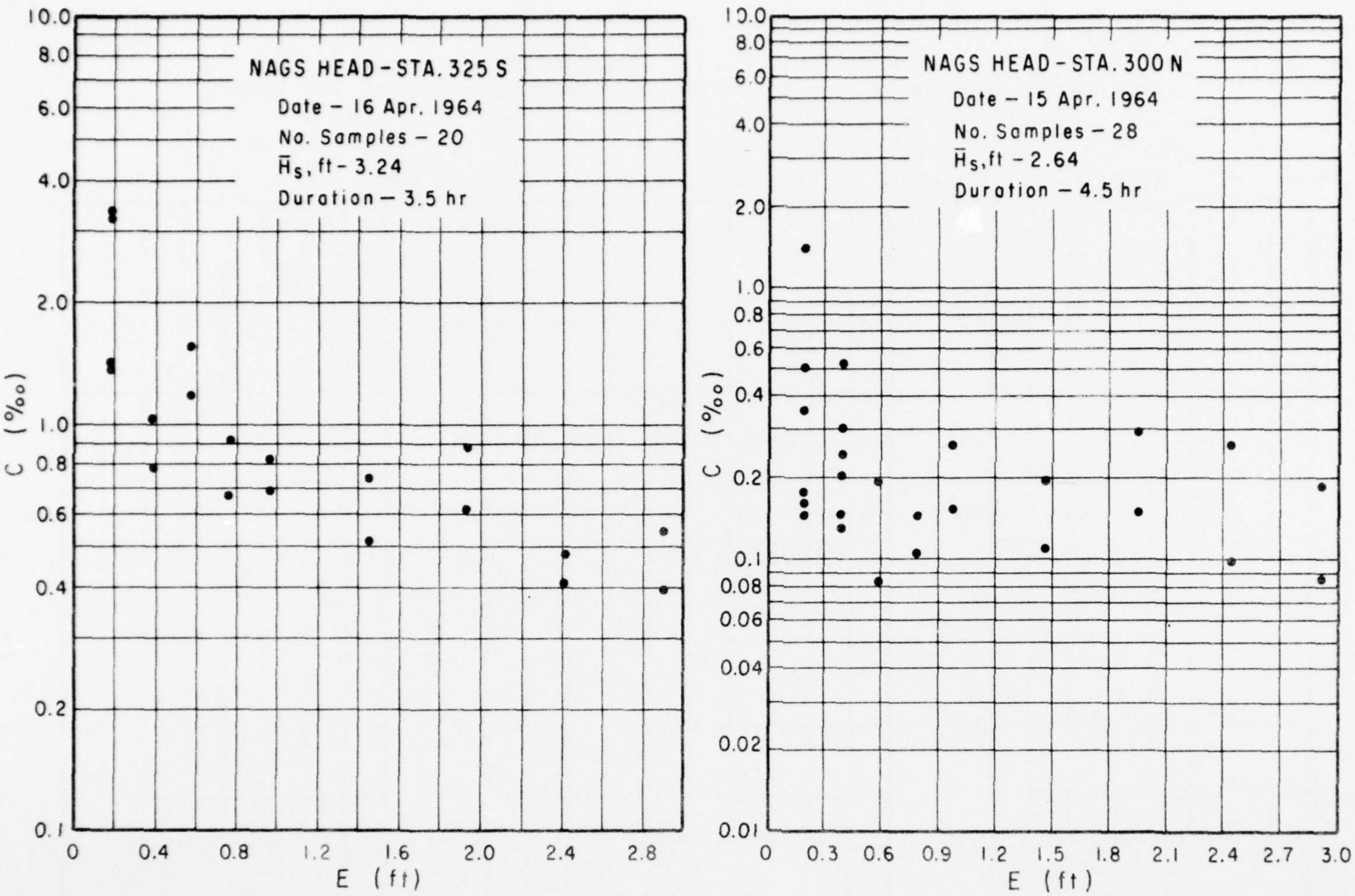


Figure 20. Decrease in concentration with elevation at Nags Head for two selected samples.

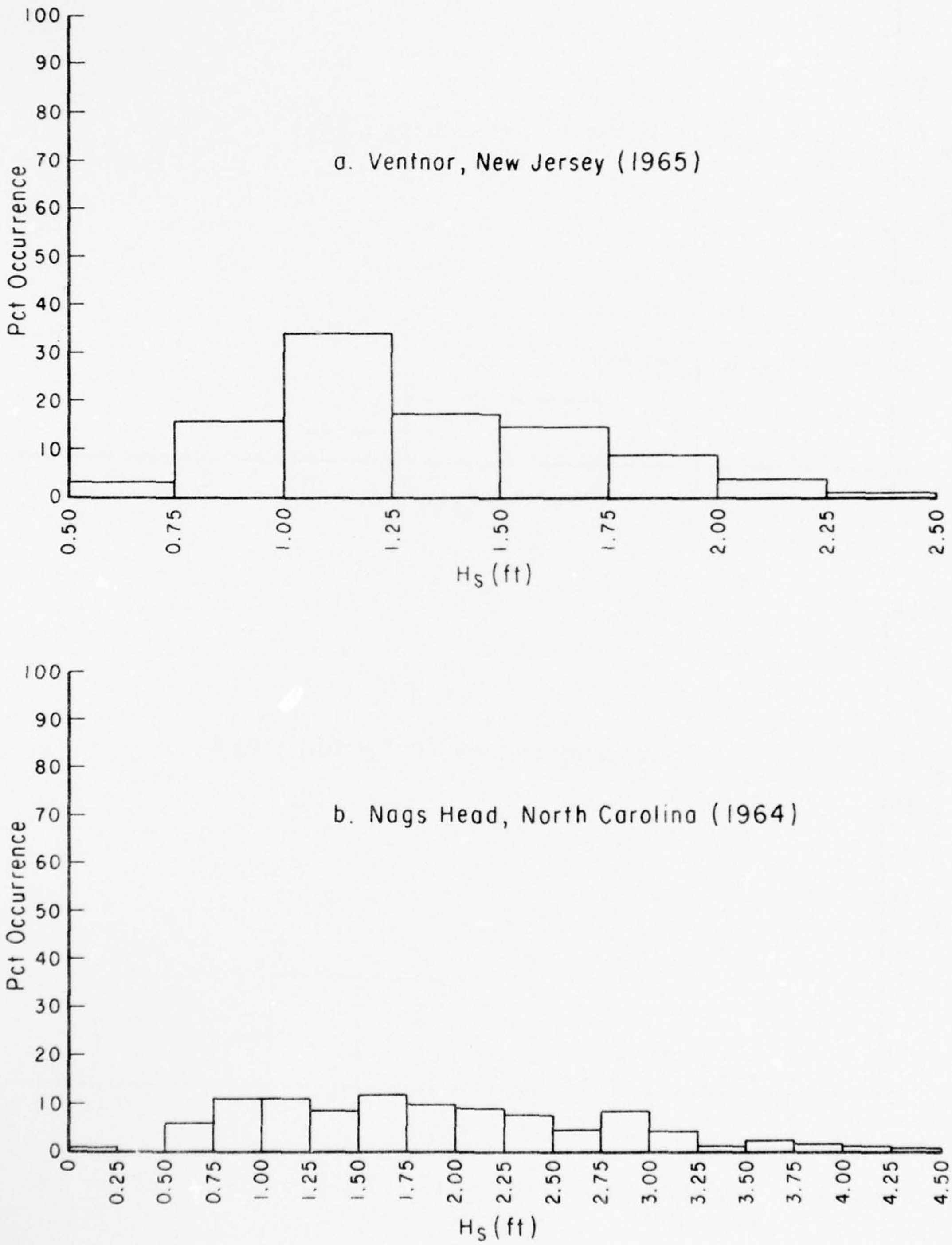


Figure 21. Distribution of wave heights during tests at Ventnor and Nags Head.

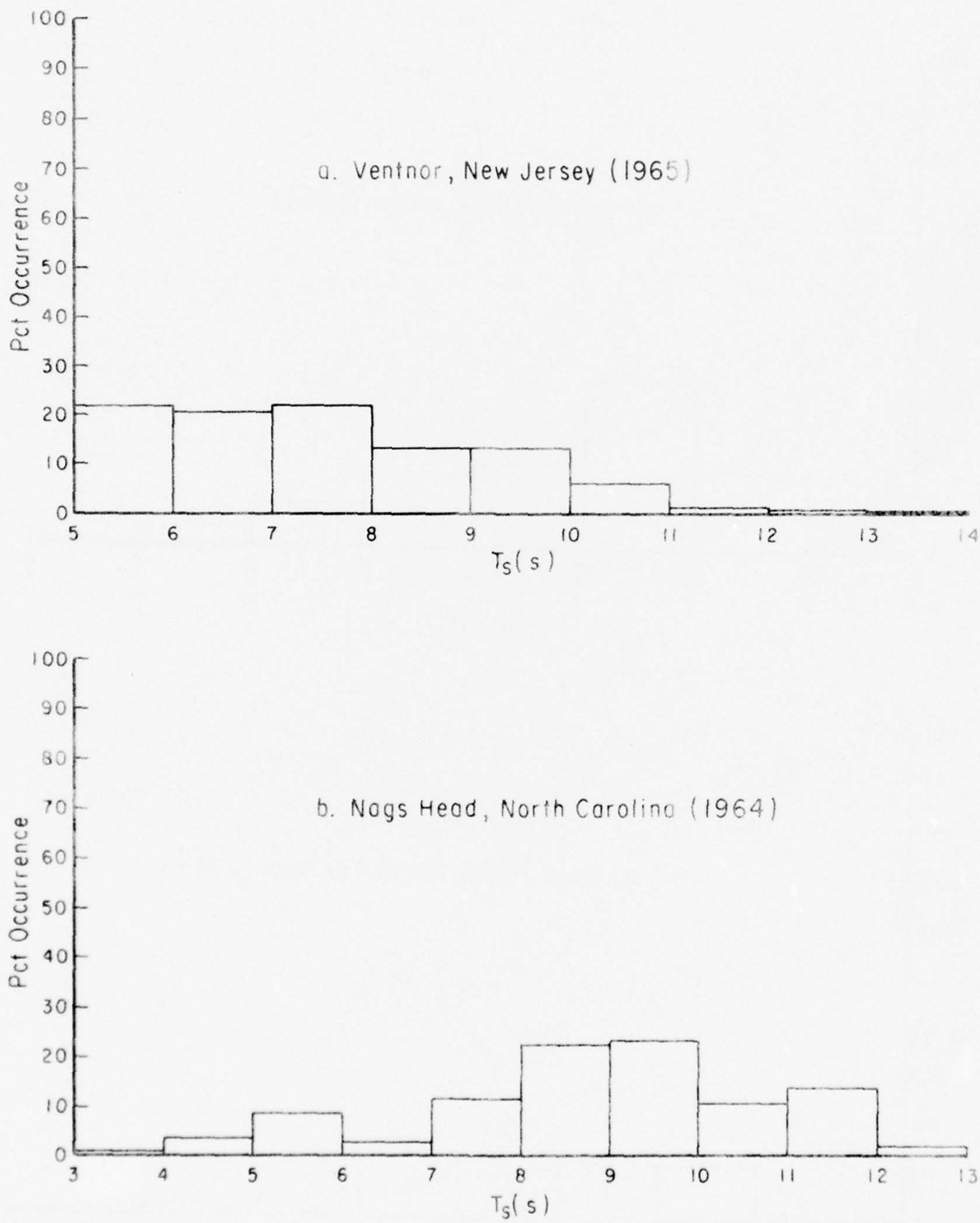


Figure 22. Distribution of wave periods during tests at Ventnor and Nags Head.

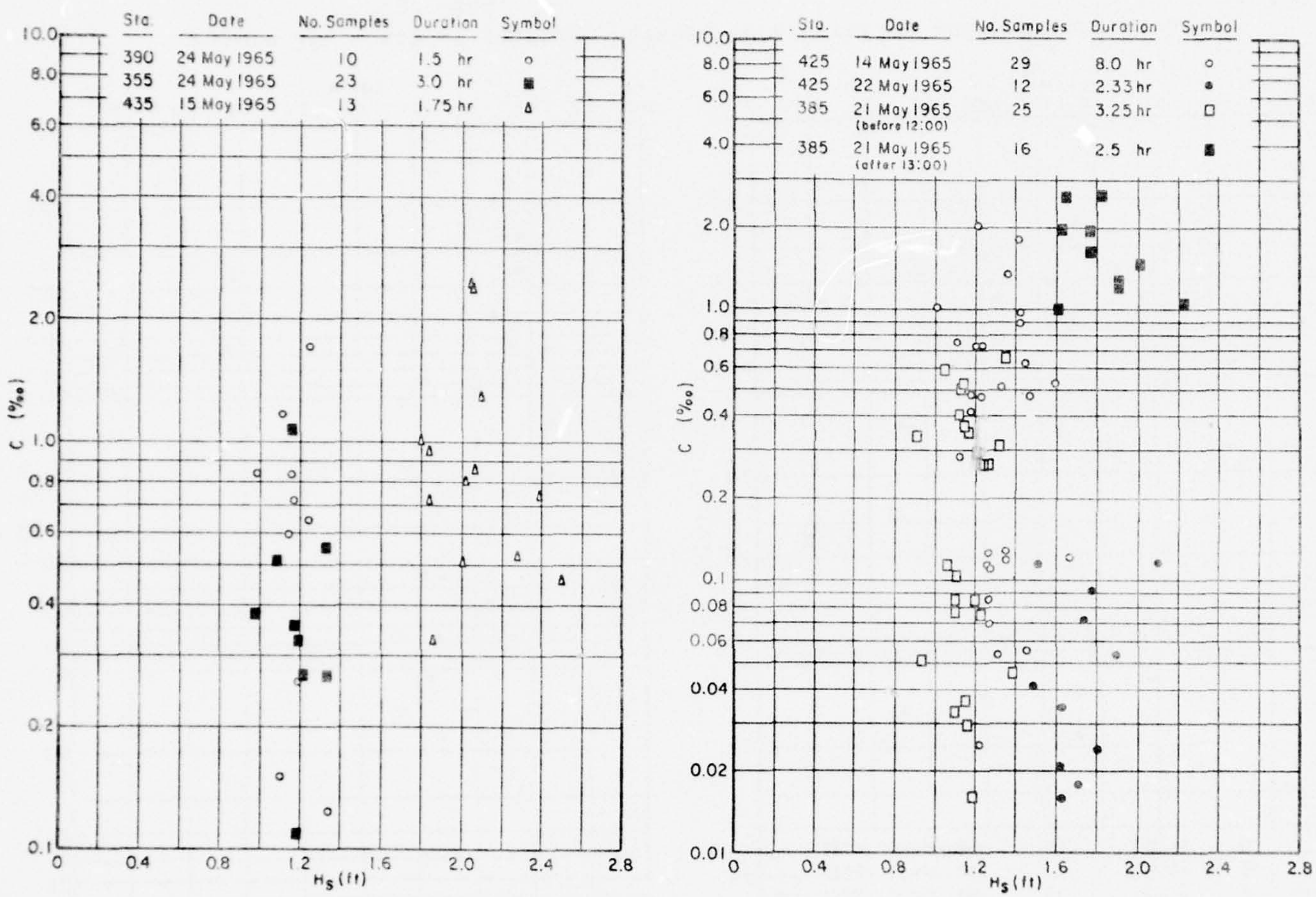


Figure 23. Lack of relation between concentration and wave height at Ventnor.

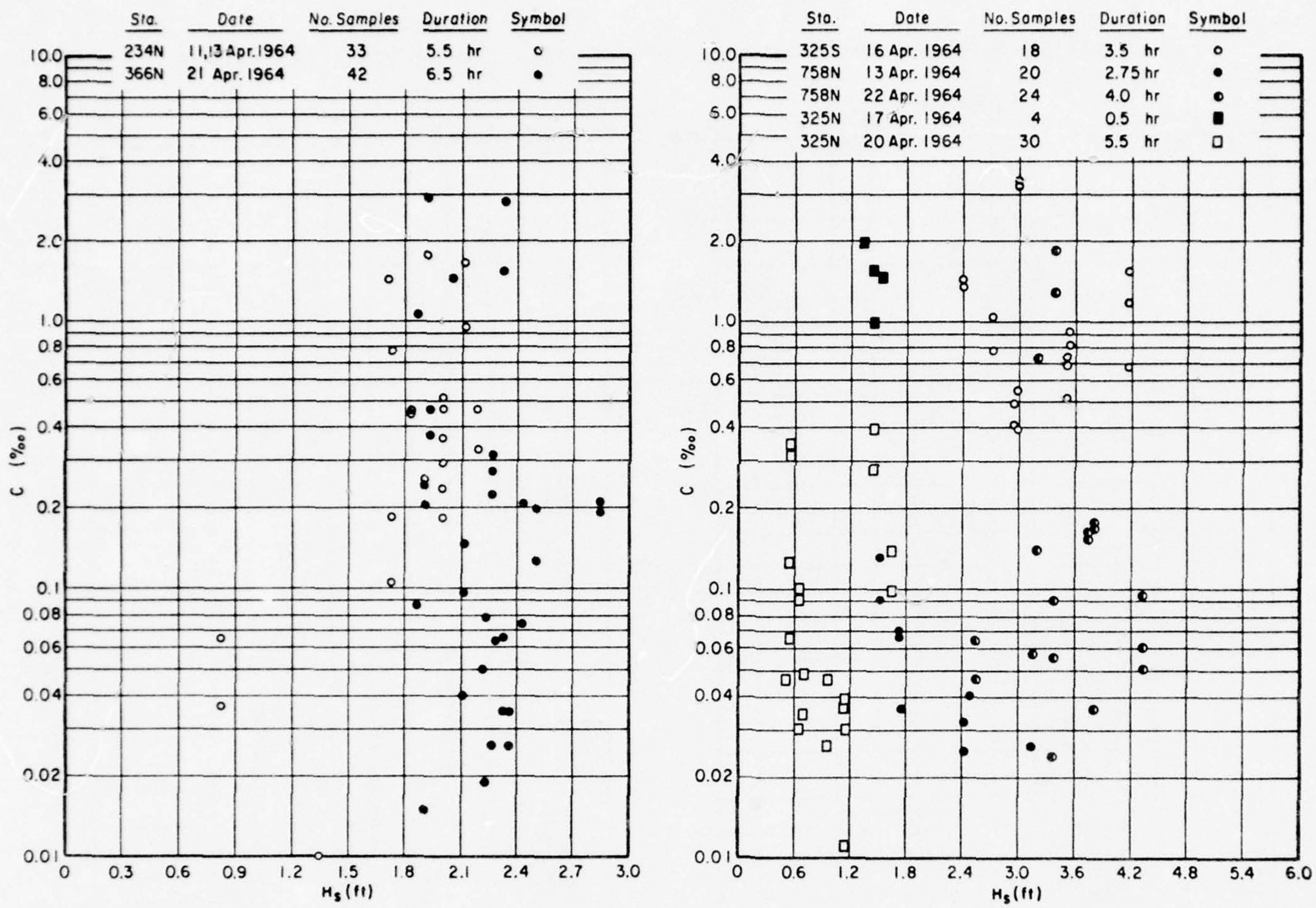


Figure 24. Lack of relation between concentration and wave height at Nags Head.

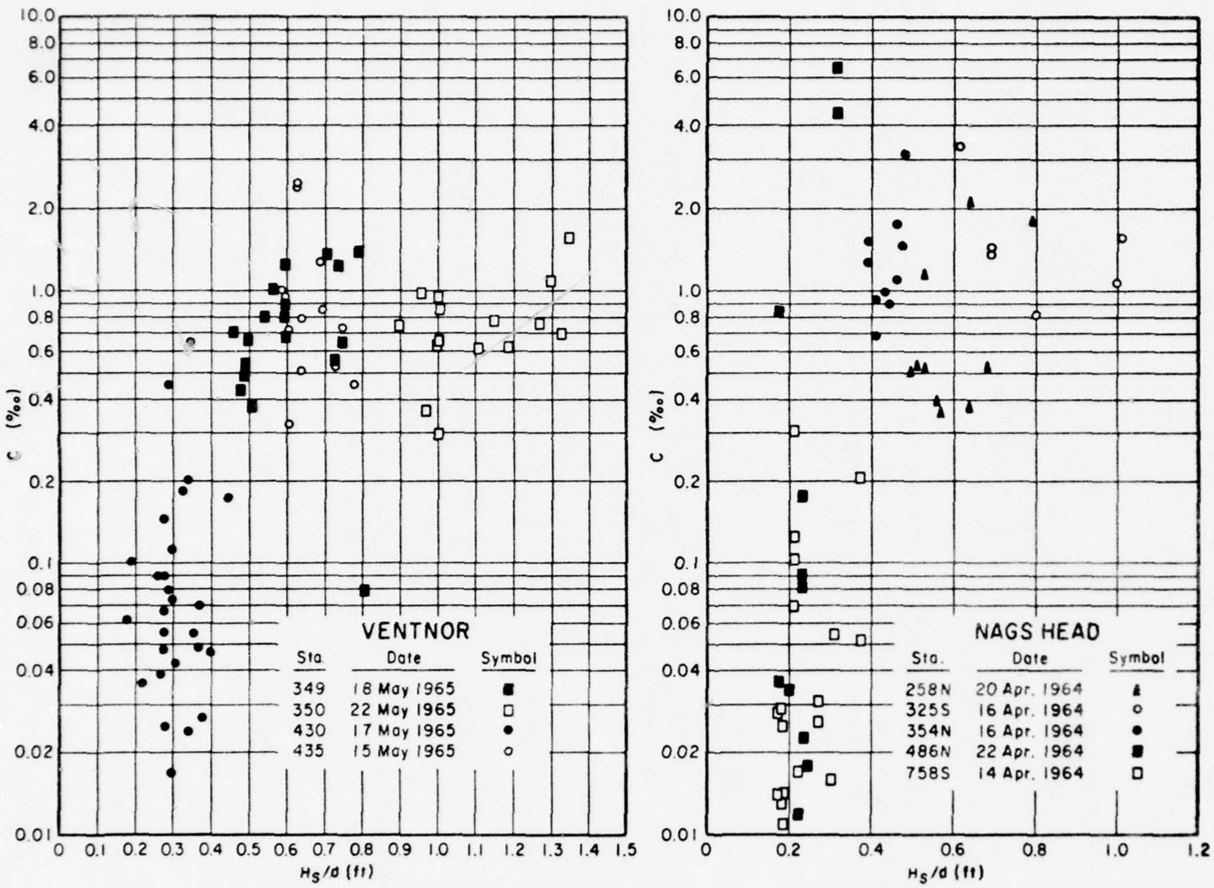


Figure 25. Dependence of maximum concentrations in height-to-depth ratio.

Short wave periods are expected to maintain a higher mean suspended-sediment concentration in the surf zone, because there is less time between waves for the sand to settle out. However, the data suggest that a detailed analysis beyond the level of this report is needed, either to prove or disprove that hypothesis. This is due to the relatively small variation in wave periods observed and the confusing effects of the other variables. In some cases where the expected relation between C and T is apparently present, variations in other variables occur which could equally explain the relation.

Breaker type was classed as spilling (sp), spilling-plunging (spp), and plunging (p); these data are tabulated in Appendix A. Although breaker type is dependent, at least in part, on wave height and period (Galvin, 1968), it is clear from this study that breaker type is important in classifying suspended-sediment data.

Figure 26 shows suspended-sediment concentrations, one set of data for each of 3 days, as a function of breaker type and distance from the breaker point. For these data, the highest concentration occurs with the plunging waves near the breaker line. The lowest concentrations occur for spilling breakers inshore of the breaker.

5. Sources of Scatter.

The figures in this report show that there are few clear trends between variables. In part this may be due to errors in measuring and processing the data; much of the scatter is due to the effects of other measured but uncontrolled variables. However, it is the author's opinion that much of the scatter is due to the difficulty of maintaining constant conditions during sampling. In particular, scatter can be due to:

(a) The unknown position of the nozzle with respect to the points along ripples where significant sediment is being entrained. Based on laboratory experience (Fairchild, 1956), it is believed that variation in actual sediment suspension along a ripple crest can cause C to vary by a factor of 5 or even 10.

(b) The unknown position of the nozzle (vertical or horizontal) with respect to ripple crests. Concentration is inversely proportional to nozzle elevation above the bottom, with concentration increasing rapidly near the bed (Fig. 19). Concentration above a ripple crest may be four or five times greater than in ripple troughs (Fairchild, 1959). Figures 18, 19, and 20 show that most samples at both piers were taken within 1 foot of the sand bottom.

Some error occurs in identifying breaker position to establish the point where $S = 0$. Errors also occur in measuring wave height and period, but these are thought to be less important sources of scatter than those due to the position of the nozzle relative to the suspended-sediment sources.

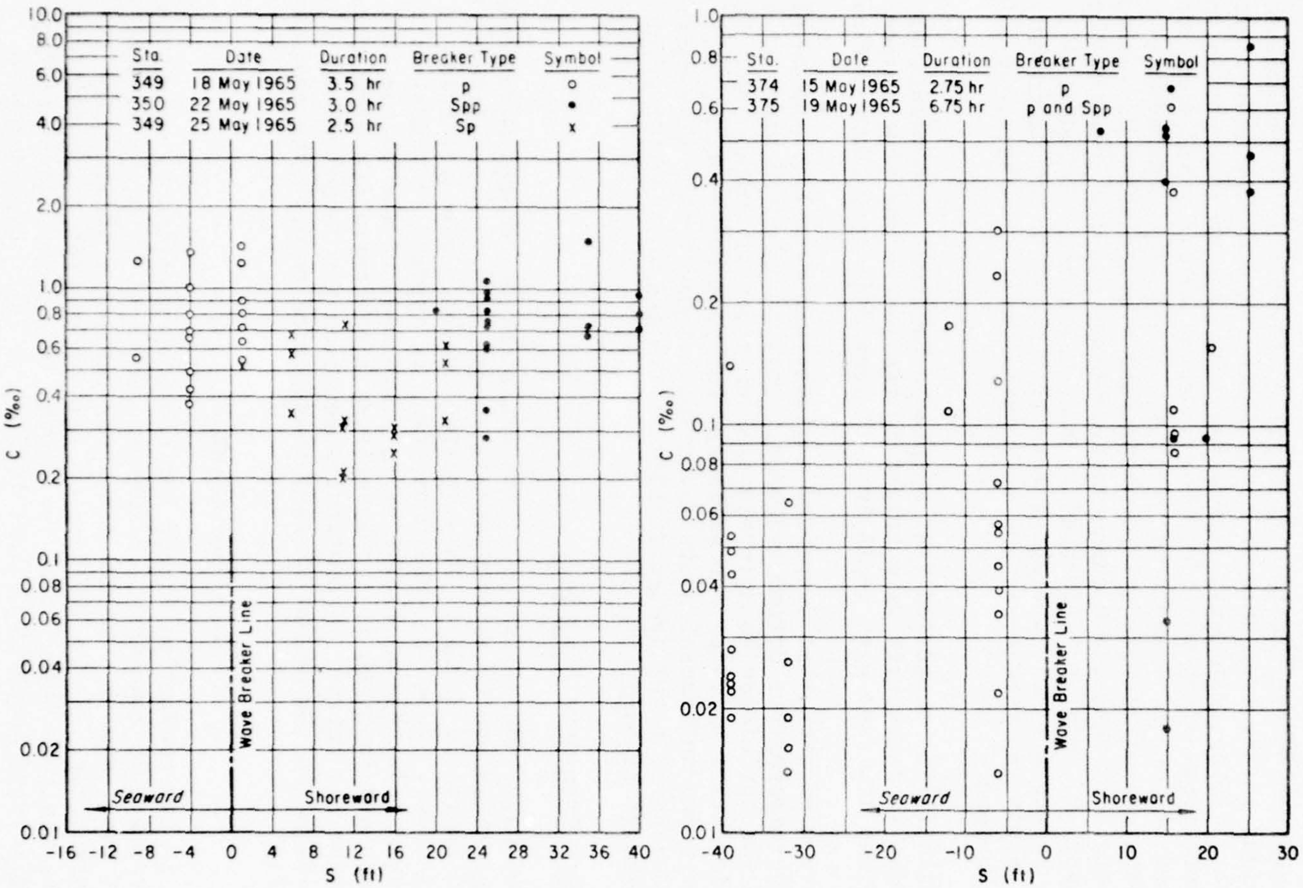


Figure 26. Increased concentration during plunging breakers at station 349, Ventnor.

IV. POTENTIAL APPLICATIONS

1. Coastal Engineering.

A primary reason for coastal engineering interest in suspended-sediment concentrations in the surf zone is to estimate the contribution of suspended sediment to littoral transport. There has long been an interest in using such concentrations, along with longshore current velocity and surf zone area, to predict longshore transport (Watts, 1953). The measurements in this report indicate a difficulty in characterizing average suspended-sediment values in the surf zone since concentration rises rapidly near the bottom (Figs. 19 and 20), and is influenced by many variables. In addition, concentration values are low, averaging less than 0.2 part per thousand in the measurements reported here, and only occasionally rising above 1.0 part per thousand.

Fairchild (1973) suggested that suspended-sediment concentrations in the surf zone increase with wave height in the same trend that suspended concentrations increase with depth in unidirectional open channel flows.

The data also show that suspended sediment has a smaller median size than the contemporaneous bottom sediment. This is expected since it is easier for the turbulence to maintain smaller sizes in suspension. Such a size differential provides the mechanism for sediment sorting, both in the longshore and onshore-offshore direction. Data on this size differential should assist in the design of beach fills and in a better understanding of longshore transport.

2. Longshore Transport Example.

Order of magnitude estimates of the contribution of suspended sediment to the total longshore transport rate have been made by Watts (1953), Galvin (1973), and Fairchild (1973). This section presents a modification of previous examples. From the data presented, it appears that most of the suspended sand is within an elevation $E_* = 0.4$ foot of the bottom, and that $C = 1.0$ parts per thousand is a characteristic concentration within that zone very near the bottom. A continuity equation for longshore transport rate, Q, based on the amount of sand transported through the near-bottom surf zone is:

$$Q = 0.65\ CE_*WV_\ell \quad , \tag{3}$$

where 0.65 is the conversion factor between concentration by weight and effective volumetric concentration (Galvin, 1973, p. 965), W is the width of the surf zone, and V_ℓ is the longshore current velocity. For the surf zones in this study, W is 300 feet or less under ordinary conditions. Usually, V_ℓ is less than 1 foot per second (U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1975, p. 4-47). Evaluating for Q with $C = 1$ part per thousand, $E_* = 0.4$ foot, $W = 300$ feet, $V_\ell = 1$ foot per second gives $Q = 91{,}000$ cubic yards per year. Evaluations of Q, thus computed, are about 10 to 20 percent of long-term estimated transport rates

at the sites, even though contributions from storms, during which when most of the transport occurs, have been omitted. If suspended-sediment transport in storms could be included in the evaluation, the factor of 10 to 20 percent noted may increase significantly. This suggests that suspended-sediment transport is an important factor in total longshore transport rate, but that the fractional proportion of Q, not including storms, may be relatively small.

3. Future Studies.

This report identifies improvements needed in future field studies of this type. It is important to be able to sample as close to the bottom as possible, without disturbing the bottom. It is important to know more precisely where the nozzle elevation is with relation to the bottom, both with respect to elevation above the mean bottom and with respect to the ripple crest. It would be useful to measure the variation in concentration in the longshore direction, possibly by simultaneously sampling from two positions along the same ripple crest. More bottom samples are needed at the time of sampling to better correlate the size differences between suspended and bottom samples. The wave conditions, including height, period, breaker type, and distance to breaker line, need to be measured at the same station as the sample collection if wave conditions are to be better correlated with suspended-sediment concentration. Data collection under higher wave conditions is needed.

Finally, the data presented in this report, especially Appendix A, can be further analyzed to yield a better understanding of suspended sediment in the surf zone. A statistical analysis, aided by physical theory, of dimensionless combinations of the independent variables in equation (1) would be especially appropriate.

V. CONCLUSIONS FROM FIELD STUDY

1. Concentration decreases logarithmically with elevation above the bottom, except very near the bottom where concentration may be higher than a logarithmic extrapolation would predict (Figs. 19 and 20).

2. Concentration increases as wave height increases relative to local water depth. Concentration rises rapidly to maximum values as the wave nears the height-to-depth ratio of 0.8 (Fig. 25).

3. Plunging breakers appear to suspend the most sediment and spilling breakers the least (Fig. 26).

4. Median size of the suspended samples decreases gradually with elevation above the bottom (Figs. 10 and 11). There is some suggestion in the Ventnor data that the median size of suspended particles is larger at the center of the breaker zone than immediately to either side of the breaker zone (Fig. 12). Also, there was less variation of sand size with nozzle height in the smaller size Ventnor sand than at Nags Head.

5. Suspended sediment in and near the surf zone is significantly finer than contemporaneous bottom sediment (Table).

6. Concentrations measured in this field study are approximately equal to those measured in the laboratory.

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APPENDIX A

COMPILATION OF SUSPENDED-SEDIMENT DATA

Compilation of data from suspended-sediment collections at the Ventnor City Pier, May 1965 (Table A-1) and the Nags Head Jennette's Pier, April 1964 (Table A-2) is as follows:

Column No.	Heading	Description[1]
1	Sample No.	Consecutive number of sample collection pumping (missing numbers are samples which were discarded or below minimum sample weight).
2	C	Concentration of sample (in parts per thousand) by weight.
3	Sta. No.	Station number is distance (in feet) from concrete wall on landward side of boardwalk at Ventnor and the shoreward end of the pier deck, landward of the dune line at Nags Head.
4	E	Nozzle height above bottom (in feet).
5	V_i	Nozzle intake velocity (in feet per second).
6	H_s	Significant wave height (in feet) from gage at station number 1015 at Ventnor and station number 650 at Nags Head.
7	d	Water depth (in feet) at point of sample collection.
8	S	Horizontal distance from the breaker line to the sampling station at the time of the sample. (Distances to stations landward of the breaker line are positive.)
9	Breaker type	Identified as: sp, spilling waves; p, plunging waves; and spp, spilling-plunging waves.
10	S_s	Distance (in feet) from sampling station to SWL-beach slope intercept.
11	T_s	Significant wave period (in seconds).
12	Tide	Water level (in feet) above or below MSL.

[1]See also Symbols and Definitions

Table A-1. Suspended-sand sampling data, Ventnor, New Jersey, May 1965.

1 Sample No.	2 C (°/oo)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
15	0.129	425	0.28	24.3	1.35	6.30	75	sp	210	5.0	+2.00
21	0.056	425	0.53	24.6	1.45	5.60	25	spp	205	5.0	+1.30
28	0.122	425	1.41	22.8	1.66	5.00	10	spp	193	5.0	+0.60
32	1.782	425	0.24	20.7	1.40	2.70	1	spp	57	5.0	-1.60
33	2.004	425	0.24	18.1	1.20	2.65	-5	spp	57	6.0	-1.65
34	1.245	425	0.34	17.5	1.20	2.65	-10	spp	57	---[1]	-1.65
35	0.728	425	0.44	20.5	1.20	2.68	-10	spp	57	5.0	-1.62
36	0.754	425	0.58	21.2	1.11	2.70	-10	spp	60	5.0	-1.60
37	1.001	425	0.68	21.3	1.00	2.70	-10	spp	60	6.0	-1.60
38	0.966	425	0.76	17.5	1.41	2.70	-10	spp	60	5.0	-1.60
39	0.516	425	0.88	19.7	1.36	2.70	-10	sp	60	5.0	-1.60
40	0.475	425	0.78	20.9	1.17	2.70	-10	sp	60	5.0	-1.60
41	0.285	425	0.68	21.9	1.11	2.70	-10	sp	60	5.0	-1.60
42	0.413	425	0.58	22.0	1.17	2.70	-10	spp	60	5.0	-1.60
43	0.716	425	0.48	22.2	1.22	2.75	+25	spp	73	5.0	-1.55
44	0.477	425	0.38	22.5	1.22	2.80	+25	p	73	5.0	-1.50
45	0.617	425	0.50	23.0	1.44	2.82	15	p	73	5.0	-1.48
46	0.896	425	0.40	16.5	1.31	2.85	15	p	73	5.0	-1.45
47	0.534	425	0.28	19.5	1.59	2.90	25	p	75	5.0	-1.40
48	1.315	425	0.38	17.7	1.35	2.96	25	p	70	5.0	-1.34
50	0.070	425	2.22	20.3	1.27	3.50	5	sp	90	6.0	-0.70
51	0.113	425	2.06	25.1	1.27	3.60	5	sp	101	6.0	-0.60
52	0.123	425	0.28	24.8	1.26	3.70	5	p	102	6.0	-0.50
53	0.054	425	0.45	24.7	1.31	3.80	10	sp	104	5.0	-0.40
54	0.120	425	0.48	25.1	1.35	3.90	15	p	110	6.0	-0.30
55	0.111	425	0.55	25.0	1.26	4.00	20	sp	112	6.0	-0.20
57	0.086	425	0.78	25.6	1.26	4.30	25	sp	115	6.0	+0.10
58	0.025	425	0.88	25.0	1.22	4.40	35	sp	119	5.0	+0.20
61	0.018	375	0.33	25.7	1.88	3.98	-15	p	170	10.0	+1.98
62	0.033	375	0.33	26.1	1.88	3.95	-15	p	167	10.0	+1.95
64	0.519	375	0.47	26.4	2.06	3.85	-15	p	160	8.0	+1.85
65	0.402	375	0.57	25.9	1.73	3.72	-15	p	158	8.0	+1.72
66	0.095	375	0.57	25.7	1.98	3.68	-15	p	158	9.0	+1.68
67	0.094	375	0.66	25.7	1.41	3.55	-20	p	158	9.0	+1.55
68	0.538	375	0.66	25.2	1.88	3.47	-15	p	158	8.0	+1.47
69	0.388	375	0.49	26.0	1.64	2.92	-25	p	137	9.0	+0.92
70	0.474	375	0.49	25.9	1.90	2.85	-25	p	120	8.0	+0.85
71	0.849	375	0.58	25.7	1.81	2.60	-25	p	90	8.0	+0.60
72	0.533	375	0.58	24.9	1.58	2.52	-7	p	83	9.0	+0.52
73	1.498	375	0.76	24.2	1.39	2.21	-7	p	80	9.0	+0.21
74	1.843	375	0.76	24.4	1.67	2.10	-7	p	78	8.0	+0.10
75	1.399	375	0.85	22.4	1.82	1.95	-7	p	65	10.0	-0.05
76	1.113	375	0.85	22.6	1.63	1.87	-7	p	60	9.0	-0.13
77	2.460	435	0.24	19.8	2.05	3.28	-7	p	77	10.0	-1.52
78	2.370	435	0.24	20.3	2.06	3.25	-7	p	77	10.0	-1.55
79	0.506	435	0.34	19.8	2.01	3.17	-7	p	72	9.0	-1.63
80	0.522	435	0.43	20.3	2.28	3.13	-15	p	70	8.0	-1.67
81	0.940	435	0.53	18.7	1.84	3.09	-290	p	70	10.0	-1.71
82	0.324	435	0.63	17.3	1.86	3.03	-290	p	68	10.0	-1.77
83	0.856	435	0.73	11.3	2.07	3.00	-290	sp	66	8.0	-1.80
84	0.717	435	0.23	19.1	1.84	3.00	-290	sp	66	10.0	-1.80
85	0.731	435	0.23	19.6	2.27	3.02	-290	sp	68	9.0	-1.78
86	1.273	435	0.33	19.7	2.10	3.05	-290	sp	68	9.0	-1.75
87	1.000	435	0.43	17.5	1.80	3.06	-290	sp	68	10.0	-1.74
88	0.793	435	0.51	18.3	2.02	3.17	-290	sp	73	10.0	-1.63
89	0.454	435	0.61	18.0	2.50	3.20	-290	sp	73	10.0	-1.60
90	0.457	430	0.22	24.9	1.66	5.78	+80	sp	204	10.0	+1.58
91	0.080	430	0.21	25.9	1.66	5.60	+80	sp	204	10.0	+1.60
92	0.091	430	0.31	26.1	1.66	5.90	+80	sp	211	10.0	+1.70
93	0.056	430	0.31	26.5	1.66	5.92	+80	sp	211	10.0	+1.72
94	0.147	430	0.41	26.0	1.66	6.03	+80	sp	213	10.0	+1.83
95	0.101	430	0.50	26.7	1.17	6.06	+55	sp	213	9.0	+1.86

[1]No data.

Table A-1. Suspended-sand sampling data, Ventnor, New Jersey, May 1965.-Continued

1 Sample No.	2 C ($^{o}/oo$)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
96	0.090	430	0.59	25.7	1.66	6.12	+55	sp	215	10.0	+1.92
97	0.112	430	0.69	26.3	1.86	6.14	+55	sp	215	10.0	+1.94
99	0.025	430	1.08	26.5	1.75	6.19	+80	spp	215	10.0	+1.99
100	0.062	430	1.28	24.6	1.13	6.19	+95	spp	215	10.0	+1.99
101	0.039	430	1.48	25.8	1.65	6.15	+85	spp	214	11.0	+1.95
102	0.036	430	1.77	25.3	1.32	6.10	+85	spp	214	11.0	+1.90
104	0.043	430	2.73	22.2	1.81	5.92	+80	spp	211	10.0	+1.72
108	0.074	430	0.20	23.7	1.24	4.20	+55	spp	140	8.0	0.00
110	0.067	430	0.30	24.2	1.10	4.00	+85	spp	95	11.0	-0.40
111	0.048	430	0.30	23.7	1.10	3.95	+85	spp	94	11.0	-0.45
112	0.202	430	0.40	22.8	1.30	3.84	+85	spp	94	10.0	-0.56
113	0.648	430	0.49	22.8	1.34	3.78	+85	spp	92	11.0	-0.62
117	0.017	430	1.20	21.0	1.02	3.36	+85	spp	83	11.0	-1.04
118	0.024	430	1.48	19.6	1.11	3.28	+85	spp	82	10.0	-1.12
120	0.176	430	0.18	19.5	1.38	3.08	+25	spp	77	11.0	-1.32
121	0.185	430	0.18	19.7	1.02	3.06	+25	spp	69	11.0	-1.34
122	0.055	430	0.28	19.6	1.09	3.00	+25	spp	67	11.0	-1.40
123	0.049	430	0.28	20.0	1.10	3.00	+25	spp	67	11.0	-1.40
124	0.070	430	0.38	19.6	1.10	3.00	+25	spp	67	7.0	-1.40
125	0.047	430	0.48	21.5	1.20	3.00	+25	spp	67	7.0	-1.40
126	0.027	430	0.57	19.2	1.15	3.03	+25	spp	69	10.0	-1.37
127	0.090	430	0.76	19.0	0.85	3.05	+25	spp	75	10.0	-1.35
128	0.025	430	0.95	19.0	---[1]	3.12	+25	spp	78	----	-1.28
130	0.053	430	1.45	19.5	----	3.18	+25	spp	80	----	-1.22
131	0.023	430	1.93	19.7	----	3.20	+25	spp	80	----	-1.20
132	0.095	430	0.28	19.8	----	3.38	+25	spp	83	----	-1.02
133	0.105	430	0.28	19.7	----	3.44	+25	spp	84	----	-0.96
134	1.236	349	0.42	22.8	1.57	2.11	+9	p	109	7.0	+1.29
135	0.553	349	0.42	23.2	1.57	2.14	+9	p	110	7.0	+1.32
136	0.644	349	0.50	24.9	1.67	2.22	-1	p	114	6.0	+1.40
137	0.806	349	0.50	24.0	1.36	2.26	-1	p	117	7.0	+1.44
138	1.398	349	0.60	24.9	1.86	2.36	-1	p	120	11.0	+1.54
139	0.887	349	0.69	24.5	1.44	2.40	-1	p	120	11.0	+1.58
140	0.541	349	0.79	25.2	1.22	2.47	-1	p	122	7.0	+1.65
141	1.254	349	0.40	25.4	1.51	2.52	-1	p	124	8.0	+1.70
142	0.710	349	0.40	25.0	1.18	2.55	-1	p	124	6.0	+1.75
143	0.804	349	0.50	24.5	1.41	2.62	+4	p	124	6.0	+1.80
144	0.431	349	0.50	24.8	1.27	2.64	+4	p	126	9.0	+1.82
145	0.659	349	0.60	25.5	1.17	2.34	+4	p	120	11.0	+1.52
146	0.486	349	0.70	24.5	1.12	2.30	+4	p	119	6.0	+1.48
147	1.005	349	0.80	24.8	1.23	2.14	+4	p	110	7.0	+1.32
148	0.682	349	0.55	25.0	1.22	2.05	+4	p	104	7.0	+1.23
149	0.377	349	0.55	24.5	1.02	2.01	+4	p	103	8.0	+1.19
150	1.342	349	0.65	18.9	1.35	1.90	+4	p	102	7.0	+1.08
151	0.079	349	0.65	9.4	1.47	1.82	+4	p	101	7.0	+1.00
152	0.033	770	0.26	22.0	1.69	8.00	441	p	441	7.0	-0.50
153	0.055	770	0.26	21.6	1.60	7.96	441	p	441	9.0	-0.54
165	0.126	374	0.48	25.3	1.15	2.05	+6	p	84	9.0	+0.44
166	0.057	374	0.58	25.2	1.53	2.11	+6	p	85	7.0	+0.50
167	0.014	374	0.66	26.0	1.31	2.13	+6	p	94	8.0	+0.52
168	0.303	374	0.74	25.5	1.30	2.27	+6	p	100	7.0	+0.66
169	0.034	374	0.88	26.2	1.40	2.41	+6	p	104	7.0	+0.80
170	0.236	374	0.93	25.6	1.12	2.43	+6	p	106	9.0	+0.82
171	0.039	374	0.98	26.2	1.14	2.56	+6	spp	125	8.0	+0.95
173	0.022	374	1.18	26.3	0.96	2.71	+6	spp	127	8.0	+1.10
174	0.054	374	1.28	26.0	1.17	2.73	+6	spp	128	7.0	+1.12
175	0.045	374	1.38	26.5	1.15	2.83	+6	spp	129	9.0	+1.22
176	0.072	374	1.43	25.7	1.24	2.87	+6	spp	129	7.0	+1.26
179	0.016	374	1.73	26.6	1.03	3.05	+32	spp	136	8.0	+1.44
181	0.014	374	1.93	26.3	1.13	3.08	+32	spp	138	7.0	+1.47
183	0.019	374	2.08	25.8	1.25	3.10	+32	spp	140	8.0	+1.49

[1]No data.

Table A-1. Suspended-sand sampling data, Ventnor, New Jersey, May 1965.-Continued

1 Sample No.	2 C ($^{o}/oo$)	3 Sta. No.	4 E (ft)	5 $V_{\bar{l}}$ (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
184	0.064	374	2.23	25.5	1.16	3.11	+32	spp	141	9.0	+1.50
185	0.014	374	0.48	28.0	1.30	3.13	+32	spp	143	7.0	+1.52
186	0.026	374	0.56	27.5	1.30	3.14	+32	spp	143	7.0	+1.53
187	0.108	374	0.66	27.6	1.04	3.19	+12	spp	145	7.0	+1.58
188	0.176	374	0.76	27.2	1.08	3.20	+12	spp	146	8.0	+1.59
189	0.024	374	0.83	27.0	0.95	3.21	+39	spp	146	8.0	+1.60
190	0.028	374	0.93	26.8	1.00	3.24	+39	spp	147	6.5	+1.63
191	0.019	374	1.03	27.2	1.05	3.24	+39	spp	147	8.0	+1.63
192	0.019	374	1.13	26.6	1.41	3.24	+39	spp	147	7.0	+1.63
193	0.023	374	1.15	26.7	1.14	3.15	+39	spp	144	7.0	+1.54
194	0.024	374	1.25	26.3	1.14	3.11	+39	spp	142	7.0	+1.50
195	0.022	374	1.32	25.2	1.24	2.21	+39	p	95	5.0	+0.60
196	0.043	374	1.42	16.1	1.24	2.16	+39	p	94	8.0	+0.55
197	0.140	374	0.42	25.7	0.95	1.99	+39	spp	80	7.0	+0.38
198	0.053	374	0.52	25.8	0.89	1.94	+39	spp	78	8.0	+0.33
199	0.049	374	0.61	25.3	1.27	1.71	+39	spp	58	8.0	+0.10
202	0.380	374	0.42	24.6	1.03	1.51	-16	spp	48	7.0	-0.10
203	0.096	374	0.52	24.8	1.03	1.33	-16	spp	41	8.0	-0.28
204	0.087	374	0.60	22.5	0.84	1.29	-16	spp	39	10.0	-0.32
205	0.110	374	0.42	24.3	1.18	1.17	-16	spp	37	9.0	-0.44
206	0.156	374	0.42	23.1	1.03	1.13	-21	spp	36	7.0	-0.48
207	1.413	360	0.37	20.9	0.87	1.15	-3	p	40	14.0	-0.25
208	0.275	360	0.37	21.7	0.90	1.20	-8	p	41	10.0	-0.20
209	0.443	360	0.47	23.4	0.94	1.32	-3	p	43	12.0	-0.08
210	0.169	360	0.47	24.2	0.93	1.36	-3	p	45	13.0	-0.04
211	0.165	360	0.57	24.4	0.98	1.60	-3	p	52	11.0	+0.20
212	0.099	360	0.57	24.6	0.83	1.66	-3	p	55	10.0	+0.26
213	0.093	360	0.67	25.0	0.85	1.83	0	--[1]	63	10.0	+0.43
218	0.031	360	0.85	24.8	0.87	1.99	+5	p	81	12.0	+0.59
219	0.030	360	0.93	25.5	0.83	2.31	+10	p	113	9.0	+0.91
220	0.033	360	0.93	25.1	0.87	2.33	+10	p	113	13.0	+0.93
221	0.078	360	0.35	26.2	0.85	2.53	+5	sp	115	8.0	+1.13
222	0.105	360	0.35	25.8	0.83	2.55	+5	sp	116	9.0	+1.15
223	0.026	360	0.45	26.4	0.79	2.59	+10	sp	117	8.0	+1.19
224	0.039	360	0.45	26.3	0.96	2.60	+10	sp	117	9.0	+1.20
225	0.033	360	0.55	26.4	0.82	2.64	+10	sp	117	7.0	+1.24
226	0.028	360	0.55	26.3	0.83	2.65	+10	sp	118	8.0	+1.25
227	0.094	360	0.65	26.4	0.79	2.69	+10	sp	118	12.0	+1.29
228	0.120	360	0.65	26.2	0.87	2.69	+10	sp	118	8.0	+1.29
230	0.039	360	0.73	26.2	0.77	2.70	+10	sp	118	10.0	+1.30
232	0.030	360	0.80	25.9	0.87	2.42	+10	sp	119	9.0	+1.02
235	0.200	360	0.35	26.3	0.80	2.10	+7	sp	80	9.0	+0.70
236	0.053	360	0.35	25.8	0.76	2.08	+7	sp	78	10.0	+0.68
238	0.092	360	0.45	25.2	0.82	1.90	+15	sp	65	8.0	+0.50
239	0.121	360	0.55	25.2	0.85	1.77	+15	sp	61	9.0	+0.37
240	0.068	360	0.55	24.8	0.98	1.75	+15	sp	60	8.0	+0.35
241	0.141	360	0.65	24.9	0.67	1.51	+15	sp	49	8.0	+0.11
242	0.220	360	0.65	24.4	0.86	1.49	+15	sp	49	9.0	+0.09
243	0.155	360	0.73	24.5	----	0.98	+15	sp	33	----	-0.42
244	0.201	360	0.73	23.9	----	1.00	+15	sp	35	----	-0.40
245	0.231	360	0.35 to 0.73	23.8	----	0.82	-15	sp	30	----	-0.58
246	0.379	360	0.73 to 0.35	19.5	----	0.80	-15	spp	29	----	-0.60
247	0.593	385	0.39	22.5	1.05	1.67	-10	spp	63	9.0	-0.81
248	0.523	385	0.39	20.2	1.14	1.68	-10	spp	63	8.0	-0.80
249	0.296	385	0.39	23.9	1.20	1.81	-10	spp	65	6.0	-0.67
250	0.403	385	0.49	24.8	1.12	1.98	-10	spp	67	11.0	-0.50
251	0.657	385	0.49	24.5	1.35	2.02	-10	spp	67	8.0	-0.46
252	0.339	385	0.59	25.0	0.91	2.15	-10	spp	67	7.0	-0.33
253	0.503	385	0.59	24.3	1.13	2.18	-10	spp	67	9.0	-0.30
254	0.350	385	0.69	25.3	1.16	2.30	-15	spp	83	7.0	-0.18
255	0.265	385	0.69	25.2	1.24	2.38	-15	spp	87	8.0	-0.10
256	0.104	385	0.79	25.4	1.09	2.58	-15	spp	93	8.0	+0.10

[1]No data.

Table A-1. Suspended-sand sampling data, Ventnor, New Jersey, May 1965.-Continued

1 Sample No.	2 C (⁰/oo)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
257	0.370	385	0.79	25.8	1.14	2.63	---[1]	spp	94	8.0	+0.15
258	0.085	385	0.85	25.9	1.10	2.83	----	spp	104	6.0	+0.35
259	0.079	385	0.85	25.7	1.10	2.88	----	spp	107	----	+0.40
260	0.036	385	0.95	25.8	1.15	2.98	----	spp	109	8.0	+0.50
261	0.312	385	0.95	25.6	1.31	3.04	+10	spp	110	8.0	+0.56
262	0.267	385	1.04	26.6	1.25	3.18	+10	spp	115	7.5	+0.70
263	0.046	385	1.04	26.0	1.38	3.21	+5	spp	116	7.0	+0.73
264	0.115	385	1.14	26.5	1.06	3.28	+5	spp	119	8.0	+0.80
265	0.016	385	1.14	26.0	1.19	3.33	+1	spp	121	7.0	+0.85
266	0.051	385	1.24	26.0	0.93	3.38	+1	spp	123	10.0	+0.90
267	0.029	385	1.24	26.2	1.16	3.40	-1	spp	124	9.0	+0.93
268	0.075	385	1.33	26.2	1.23	3.48	-5	spp	126	8.0	+1.00
269	0.085	385	1.33	26.0	1.20	3.49	-5	spp	126	9.0	+1.01
270	0.033	385	1.41	26.5	1.10	3.54	-10	spp	128	8.0	+1.06
271	0.022	385	1.41	26.1	----	3.56	-10	spp	129	----	+1.08
272	1.062	385	0.32	27.2	----	3.58	-15	p	129	----	+1.10
273	1.370	385	0.42	25.8	----	3.56	-15	p	129	----	+1.08
274	1.144	385	0.52	26.3	----	3.54	-15	p	128	----	+1.06
275	1.127	385	0.60	26.8	----	3.49	-12	p	126	----	+1.01
276	2.035	385	0.67	25.1	----	3.48	-12	p	126	----	+1.00
277	2.433	385	0.81	23.6	----	3.46	-12	p	125	----	+0.98
278	1.973	385	0.88	26.3	1.62	3.38	-10	p	123	6.0	+0.90
279	1.035	385	0.97	26.1	2.22	3.36	-10	p	122	6.0	+0.88
280	1.259	385	1.09	26.0	1.90	3.19	-20	p	115	5.5	+0.71
281	1.197	385	1.18	25.4	1.90	3.17	-25	p	115	----	+0.69
282	1.606	385	1.26	25.8	1.76	2.78	-25	p	104	6.0	+0.30
283	1.910	385	1.36	24.5	1.76	2.76	-35	p	102	7.0	+0.28
284	1.455	385	1.45	24.3	2.01	2.68	-35	p	99	8.0	+0.20
286	2.560	385	0.31	26.1	1.64	2.51	-15	p	91	8.0	+0.03
287	0.982	385	0.41	11.6	1.60	2.47	-15	p	89	8.0	-0.01
288	2.601	385	0.51	24.3	1.82	2.38	-15	p	87	9.6	-0.10
290	0.034	425	0.47	21.7	1.62	2.80	+20	p	52	8.0	-1.30
291	0.092	425	0.47	21.0	1.77	2.81	+20	p	52	6.0	-1.29
292	0.117	425	0.57	21.7	1.50	2.88	+20	p	65	6.0	-1.22
293	0.072	425	0.67	21.6	1.73	2.99	+15	spp	74	6.0	-1.10
294	0.054	425	0.74	24 2	1.89	3.00	+15	spp	74	6.0	-1.10
295	0.018	425	0.82	23.4	1.71	3.05	+20	spp	75	8.0	-1.05
296	0.041	425	0.92	23.5	1.48	3.12	+20	spp	77	8.0	-0.98
297	0.021	425	1.02	23.3	1.62	3.15	+25	spp	79	9.0	-0.95
299	0.030	425	1.19	24.2	1.62	3.30	+30	spp	89	----	-0.80
303	0.024	425	1.37	24.8	1.80	3.85	+35	spp	129	9.0	-0.25
304	0.016	425	1.47	20.6	1.63	3.92	+35	spp	129	7.0	-0.18
305	0.118	425	1.56	24.6	2.10	3.95	+35	spp	129	6.0	-0.15
306	0.837	350	0.46	19.1	----	1.12	-20	spp	58	----	+0.10
307	0.727	350	0.46	20.9	----	1.14	-40	spp	60	----	+0.12
308	0.974	350	0.56	22.9	----	1.16	-40	spp	60	----	+0.14
309	0.831	350	0.56	23.2	----	1.17	-40	spp	60	----	+0.15
310	0.608	350	0.46	25.4	1.69	1.52	-25	spp	80	6.0	+0.50
311	0.945	350	0.56	11.7	1.56	1.53	-25	spp	80	8.0	+0.51
312	0.362	350	0.66	25.4	1.53	1.57	-25	spp	82	8.0	+0.55
313	0.977	350	0.73	24.9	1.51	1.58	-25	spp	82	8.0	+0.56
314	0.615	350	0.81	24.0	1.89	1.57	-25	spp	82	7.0	+0.55
315	0.294	350	0.91	24.9	1.64	1.57	-25	spp	82	6.5	+0.55
316	0.745	350	1.00	23.6	1.40	1.55	-25	spp	81	6.0	+0.53
317	0.764	350	1.10	16.9	1.75	1.52	-25	spp	80	7.0	+0.50
318	0.628	350	0.43	25.7	1.52	1.50	-25	spp	77	8.0	+0.48
319	1.081	350	0.53	23.8	1.91	1.47	-25	spp	75	6.0	+0.45
320	0.845	350	0.63	25.0	1.52	1.42	-25	spp	74	7.0	+0.40
321	0.644	350	0.70	19.9	1.48	1.41	-25	spp	74	7.0	+0.39
322	0.748	350	0.80	20.4	1.49	1.17	-35	spp	60	7.0	+0.15
323	1.523	350	0.43	24.0	1.49	1.10	-35	spp	58	6.0	+0.08
324	0.686	350	0.53	24.0	1.37	1.03	-35	spp	57	8.0	+0.01

[1] No data.

Table A-1. Suspended-sand sampling data, Ventnor, New Jersey, May 1965.-Continued

1 Sample No.	2 C ($^{0}/oo$)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
325	1.709	390	0.46	16.7	1.25	1.00	-10	sp	26	7.0	-1.32
326	0.644	390	0.46	22.4	1.24	1.02	-10	sp	27	7.0	-1.30
327	0.833	390	0.56	21.4	1.16	1.14	-0	sp	38	6.0	-1.18
328	0.715	390	0.56	22.0	1.17	1.17	-0	sp	38	6.0	-1.15
329	1.168	390	0.66	23.6	1.12	1.54	-0	sp	55	7.0	-0.78
330	0.593	390	0.76	24.0	1.14	1.58	0	sp	55	7.0	-0.74
331	0.259	390	0.83	24.6	1.18	1.75	0	sp	78	7.0	-0.57
332	0.836	390	0.91	23.8	0.98	1.80	0	sp	78	8.0	-0.52
333	0.123	390	1.00	24.2	1.34	2.00	0	sp	93	5.0	-0.32
334	0.151	390	1.10	24.3	1.10	2.07	0	sp	94	6.0	-0.25
335	1.062	355	0.48	25.8	1.16	2.03	0	sp	80	7.0	+0.43
336	0.324	355	0.58	25.6	1.19	2.05	0	sp	85	7.0	+0.50
337	0.509	355	0.68	26.0	1.09	2.11	0	sp	87	6.0	+0.56
338	0.546	355	0.75	25.2	1.33	2.13	0	sp	88	7.0	+0.58
339	0.379	355	0.84	25.8	0.98	2.17	0	sp	90	9.0	+0.62
340	0.468	355	0.91	23.3	---[1]	2.20	0	sp	91	----	+0.65
341	0.267	355	1.03	25.5	1.33	2.24	0	sp	93	7.0	+0.69
342	0.353	355	1.10	24.8	1.18	2.25	-10	sp	93	6.0	+0.70
343	0.109	355	1.19	25.0	1.19	2.33	-10	sp	95	7.0	+0.78
344	0.266	355	1.28	20.2	1.22	2.36	-10	sp	96	6.0	+0.81
345	1.450	355	0.44	19.7	----	2.46	-20	sp	97	----	+1.00
346	1.455	355	0.54	24.9	----	2.59	-20	sp	100	----	+1.13
347	0.830	355	0.64	27.4	----	2.66	-8	p	103	----	+1.20
349	0.444	355	0.78	27.2	----	2.81	-10	p	106	----	+1.35
350	0.332	355	0.87	26.7	----	2.84	-10	p	107	----	+1.38
351	1.020	355	0.97	27.2	----	2.91	-10	p	108	----	+1.45
352	1.376	355	1.07	26.1	----	2.92	-10	spp	108	----	+1.46
353	0.453	355	1.16	18.2	----	2.92	-10	spp	108	----	+1.46
354	0.343	355	1.25	16.0	----	2.88	-10	spp	107	----	+1.42
355	0.734	355	1.34	21.4	----	2.76	-10	spp	106	----	+1.30
356	0.383	355	1.43	22.0	----	2.70	-5	spp	105	----	+1.24
357	0.273	355	1.62	25.4	----	3.54	-15	spp	102	----	+1.18
358	0.333	355	1.72	23.4	----	3.51	-25	spp	101	----	+1.15
359	1.097	427	0.26	22.0	----	2.65	+17	spp	56	----	-1.65
360	0.268	427	0.36	22.3	----	2.50	+17	spp	53	----	-1.80
361	0.512	427	0.46	23.0	----	2.40	+17	spp	52	----	-1.90
362	0.243	427	0.55	23.5	----	2.30	+17	spp	48	----	-2.00
363	0.511	427	0.62	22.9	----	2.20	+17	spp	45	----	-2.10
365	0.049	427	0.81	22.8	----	2.30	+17	sp	53	----	-1.80
366	0.119	427	0.91	22.4	----	2.53	+37	sp	54	----	-1.77
367	0.098	427	1.01	22.9	----	2.60	+37	sp	55	----	-1.70
368	0.076	427	1.12	22.6	----	2.65	+37	sp	56	----	-1.65
369	0.029	427	1.21	23.0	----	2.78	+37	sp	59	----	-1.52
370	0.031	427	1.31	22.8	----	2.80	+37	sp	60	----	-1.50
371	0.068	427	1.41	23.0	----	2.87	+37	sp	65	----	-1.43
372	0.028	427	1.46	22.8	----	2.90	+37	sp	69	----	-1.40
373	0.026	427	1.56	23.0	----	2.80	+27	sp	73	----	-1.30
375	0.745	349	0.42	24.6	----	0.91	-11	sp	43	----	-0.10
376	0.521	349	0.52	25.0	----	0.92	-1	sp	43	----	0
377	0.331	349	0.62	24.9	----	1.04	-21	sp	44	----	+0.12
378	0.616	349	0.72	24.6	----	1.07	-21	sp	44	----	+0.15
379	0.536	349	0.80	25.0	----	1.17	-21	sp	45	----	+0.25
381	0.599	349	0.42	21.4	----	1.22	-21	sp	45	----	+0.30
382	0.568	349	0.52	24.6	----	1.32	-6	sp	46	----	+0.40
383	0.684	349	0.62	25.1	----	1.42	-6	sp	47	----	+0.50
384	0.349	349	0.72	25.4	----	1.42	-6	sp	47	----	+0.50
385	0.304	349	0.78	25.5	----	1.45	-16	sp	47	----	+0.53
386	0.285	349	0.88	25.0	----	1.47	-16	sp	47	----	+0.55
387	0.310	349	0.97	25.3	----	1.53	-11	sp	48	----	+0.61
388	0.211	349	1.07	24.8	----	1.55	-11	sp	48	----	+0.63
389	0.250	349	1.16	25.4	----	1.62	-16	sp	49	----	+0.70
390	0.328	349	1.25	24.8	----	1.63	-11	sp	49	----	+0.71

[1]No data.

Table A-1. Suspended-sand sampling data, Ventnor, New Jersey, May 1965.-Continued

1 Sample No.	2 C (°/oo)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
391	0.205	349	1.34	24.8	---[1]	1.74	-11	sp	77	----	+0.82
392	0.045	427	0.26	22.6	----	3.91	+47	p	93	----	-0.30
393	0.057	427	0.36	23.6	----	3.90	+47	p	93	----	-0.31
394	0.100	427	0.46	24.0	----	3.61	+47	p	92	----	-0.60
395	0.032	427	0.56	23.4	----	3.57	+47	p	81	----	-0.70
396	0.020	427	0.66	23.6	----	3.31	+47	p	79	----	-0.90
397	0.056	427	0.76	23.5	----	3.21	+47	p	78	----	-1.00
398	0.028	427	0.86	24.0	----	3.11	+32	p	77	----	-1.10
399	0.024	427	0.96	23.0	----	3.06	+32	p	76	----	-1.15
400	0.022	427	1.06	23.0	----	2.96	+32	p	74	----	-1.25
401	0.024	427	1.16	22.6	----	2.81	+27	p	67	----	-1.40
402	0.053	427	1.24	21.7	----	2.56	+27	p	60	----	-1.65
403	0.023	427	1.34	22.2	----	2.55	+27	p	60	----	-1.66
405	0.053	427	0.25	22.0	----	2.51	+27	p	59	----	-1.70
406	0.048	427	0.35	22.0	----	2.51	+22	p	59	----	-1.70
407	0.077	427	0.45	21.0	----	2.53	+22	p	59	----	-1.68
408	0.043	427	0.55	22.1	----	2.61	+22	p	61	----	-1.60
409	0.020	427	0.64	22.5	----	2.62	+22	p	61	----	-1.59
410	0.044	392	0.46	24.1	----	1.40	+12	p	58	----	-0.30
411	0.061	392	0.56	24.7	----	1.55	+12	p	59	----	-0.15
412	0.027	392	0.65	24.8	----	1.66	+12	p	60	----	-0.04
413	0.035	392	0.71	24.9	----	1.78	+12	p	60	----	+0.08
414	0.047	392	0.82	25.0	----	1.97	----	p	61	----	+0.27
415	0.039	392	0.95	28.6	----	2.10	----	p	61	----	+0.40

[1]No data.

Table A-2, Suspended-sand sampling data, Nags Head, North Carolina April 1964.

1 Sample No.	2 C (°/oo)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
1	0.141	352.5-N	0.19	20.5	0.70	2.94	--[1]	sp	81	8.9	-0.88
2	0.402	352.5-N	0.19	20.1	----	2.54	---	sp	66	9.1	-1.28
3	0.599	352.5-N	0.19	18.9	----	2.53	---	sp	66	9.1	-1.29
4	0.194	352.5-N	0.19	20.7	0.83	2.39	---	sp	60	8.8	-1.43
5	0.237	352.5-N	0.19	19.7	0.83	2.40	---	sp	61	8.8	-1.42
6	0.823	352.5-N	0.39	21.0	1.36	2.44	---	sp	63	8.3	-1.38
7	0.723	352.5-N	0.39	20.1	1.36	2.44	---	sp	63	8.3	-1.38
8	-----	352.5-N	0.58	----	0.87	2.49	---	sp	64	10.1	-1.33
9	0.060	352.5-N	0.58	20.4	0.87	2.52	---	sp	65	10.1	-1.30
10	0.063	352.5-N	0.78	21.6	1.11	2.62	320	sp	68	8.5	-1.20
12	0.006	352.5-N	0.97	----	1.17	2.82	313	sp	74	8.0	-1.00
13	0.031	352.5-N	0.97	21.0	1.17	2.86	313	sp	76	8.0	-0.96
14	0.016	352.5-N	1.16	----	1.17	2.99	313	sp	83	8.0	-0.83
15	0.005	352.5-N	1.16	----	1.11	3.01	313	sp	84	9.0	-0.81
16	-----	352.5-N	1.65	----	1.11	3.12	305	sp	153	9.0	-0.70
17	-----	352.5-N	1.65	----	1.11	3.19	305	sp	155	9.0	-0.63
18	0.288	352.5-N	0.19	22.4	1.00	3.20	---	sp	155	8.9	-0.62
19	0.031	352.5-N	0.68	21.6	1.00	3.34	---	sp	158	8.9	-0.48
20	0.014	352.5-N	1.16	----	1.31	3.45	---	sp	160	8.3	-0.37
21	0.019	352.5-N	1.65	----	1.31	3.54	295	sp	162	8.3	-0.28
22	0.059	257.5-N	0.19	21.1	1.37	0.86	270	sp	72	8.8	+0.03
23	0.044	257.5-N	0.39	19.9	1.37	0.99	270	sp	74	8.8	0.16
24	0.045	257.5-N	0.58	20.9	1.28	1.01	270	sp	75	3.8	0.18
25	0.030	257.5-N	0.77	19.1	1.28	1.12	---	sp	77	3.8	0.29
26	0.044	257.5-N	0.19	21.2	1.28	1.23	220	sp	78	3.8	+0.40
27	0.064	257.5-N	0.19	20.3	1.21	1.23	220	sp	78	9.1	0.40
28	0.118	285 -N	0.20	21.0	0.74	2.14	290	p	115	11.5	0.94
29	0.118	285 -N	0.39	20.[illegible]	0.74	2.12	290	p	115	11.5	0.92
30	-----	500 -N	0.20	----	0.73	13.88	320	p	323	11.6	0.53
31	-----	500 -N	0.20	----	0.73	13.07	320	p	323	11.6	0.52
32	-----	500 -N	0.49	----	0.81	12.92	320	p	320	10.9	0.37
33	-----	500 -N	0.49	----	0.81	12.90	320	p	320	10.9	0.35
34	-----	500 -N	0.97	----	----	12.70	---	p	317	----	0.15
35	-----	500 -N	0.97	----	----	12.68	---	p	316	10.9	+0.13
36	-----	500 -N	1.95	----	0.95	12.48	---	p	313	12.7	-0.08
37	-----	500 -N	1.95	----	0.95	12.52	---	p	314	12.7	-0.04
38	-----	500 -N	3.90	----	0.81	12.36	---	p	310	11.9	-0.21
39	-----	500 -N	3.90	----	0.81	12.34	---	p	310	11.9	-0.23
40	-----	500 -N	5.85	----	0.70	12.24	355	p	308	11.5	-0.34
41	-----	500 -N	5.85	----	0.70	12.20	355	p	307	11.5	-0.38
42	-----	500 -N	7.80	----	0.70	12.08	355	p	305	11.5	-0.51
43	-----	500 -N	7.80	----	0.73	12.03	350	p	304	12.2	-0.56
44	-----	500 -N	9.74	----	0.73	11.86	350	p	300	12.2	-0.74
45	-----	500 -N	9.74	----	0.73	11.83	350	p	300	12.2	-0.77
46	-----	500 -N	10.72	----	0.82	11.04	---	p	203	10.6	-1.63
47	-----	500 -N	10.72	----	0.82	11.03	---	p	202	10.6	-1.64
48	-----	500 -N	0.20	----	0.91	11.01	165	p	202	11.3	-1.67
49	-----	500 -N	0.20	----	0.91	11.00	165	p	202	11.3	-1.68
50	-----	500 -N	0.49	----	0.98	10.99	165	p	201	11.3	-1.70
51	-----	500 -N	0.49	----	0.98	10.99	165	p	201	11.3	-1.70
52	0.065	234 -N	0.19	20.2	0.83	0.16	165	sp	15	10.8	-1.64
53	0.036	234 -N	0.19	----	0.83	0.17	165	sp	15	10.8	-1.63
54	-----	234 -N	0.39	----	0.83	0.23	165	sp	16	10.8	-1.58
55	0.010	234 -N	0.39	----	1.35	0.25	165	sp	16	11.6	-1.56
56	-----	234 -N	0.58	----	1.35	0.28	165	sp	16	11.6	-1.54
57	-----	234 -N	0.58	----	1.35	0.30	165	sp	17	11.6	-1.52
58	-----	234 -N	0.77	----	0.98	0.40	165	sp	18	11.2	-1.43
59	-----	234 -N	0.77	----	0.98	0.43	165	sp	19	11.2	-1.40
60	-----	234 -N	0.97	----	0.98	0.61	165	sp	22	11.2	-1.23
61	-----	234 -N	0.97	----	0.98	0.61	165	sp	22	11.4	-1.23
62	-----	234 -N	1.16	----	0.98	0.67	---	sp	23	11.4	-1.18

[1]No data.

Table A-2. Suspended-sand sampling data, Nags Head, North Carolina April 1964.-Continued

1 Sample No.	2 C ($^{o}/oo$)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
63	----[1]	234 -N	1.16	----	0.98	0.69	---	sp	24	11.4	-1.16
64	-----	234 -N	1.35	----	0.85	0.89	201	sp	29	11.5	-0.97
65	-----	234 -N	1.35	----	0.82	0.92	210	sp	29	11.5	-0.94
66	0.328	234 -N	0.20	25.5	2.18	4.70	210	sp	72	6.6	+1.14
67	0.461	234 -N	0.20	24.4	2.18	4.72	210	sp	72	6.6	1.15
68	0.452	234 -N	0.39	23.7	1.82	4.74	210	sp	73	9.2	1.17
69	0.457	234 -N	0.39	25.5	1.82	4.76	210	sp	74	9.2	1.18
70	0.292	234 -N	0.39	24.5	2.00	4.78	210	sp	74	8.0	1.18
71	0.514	234 -N	0.39	23.2	2.00	4.77	210	sp	73	8.0	1.17
72	0.183	234 -N	0.59	23.7	1.73	4.75	---	sp	72	6.9	1.14
73	0.777	234 -N	0.59	22.1	1.73	4.74	---	sp	72	6.9	1.13
74	0.105	234 -N	0.78	23.3	1.73	4.72	---	sp	71	6.9	1.10
75	0.320	234 -N	0.78	21.8	----	4.72	---	sp	70	----	1.09
76	0.463	234 -N	0.98	22.6	2.00	4.61	---	sp	66	8.7	+0.97
77	0.185	234 -N	0.98	21.2	2.00	4.59	---	sp	172	8.7	0.95
78	0.235	234 -N	1.18	21.7	2.00	4.52	---	sp	169	8.7	0.87
79	0.361	234 -N	1.18	20.4	2.00	4.48	---	sp	168	8.7	0.83
80	0.253	234 -N	1.37	16.5	1.92	4.30	---	sp	161	7.2	0.64
81	1.774	234 -N	0.20	20.7	1.92	4.28	---	sp	161	7.2	0.62
82	1.438	234 -N	0.20	20.6	1.71	4.11	---	sp	154	6.8	0.43
83	1.689	234 -N	0.39	20.2	2.12	3.88	---	sp	146	6.7	0.19
84	0.951	234 -N	0.39	19.2	2.12	3.87	---	sp	145	6.7	+0.18
85	0.131	758 -N	0.19	21.5	1.52	9.89	---	sp	585	8.4	-1.52
86	0.092	758 -N	0.19	20.5	1.52	9.88	---	sp	585	8.4	-1.53
87	0.066	758 -N	0.39	21.7	1.72	9.77	---	--	580	7.5	-1.66
88	0.070	758 -N	0.39	20.9	1.72	9.77	---	--	580	7.5	-1.66
89	-----	758 -N	0.58	----	1.72	9.71	---	--	578	7.5	-1.72
90	0.036	758 -N	0.58	20.9	1.77	9.72	---	--	578	7.9	-1.72
91	0.025	758 -N	0.97	22.6	2.43	9.68	---	--	576	8.0	-1.78
92	0.032	758 -N	0.97	21.4	2.43	9.68	---	--	576	8.0	-1.78
93	0.026	758 -N	1.45	23.0	3.16	9.68	---	--	576	8.0	-1.79
94	-----	758 -N	1.45	----	3.16	9.70	---	--	577	8.0	-1.77
95	-----	758 -N	1.93	----	2.49	9.73	---	--	579	8.2	-1.75
96	0.040	758 -N	1.93	21.4	2.49	9.76	---	--	580	8.2	-1.73
97	0.006	758 -N	2.90	----	2.29	9.81	---	--	582	7.5	-1.69
98	-----	758 -N	2.90	----	2.29	9.82	---	--	582	7.5	-1.68
99	0.003	758 -N	3.86	----	2.36	9.88	---	--	585	8.2	-1.63
100	-----	758 -N	3.86	----	2.36	9.91	---	--	586	8.2	-1.60
101	0.006	758 -N	4.83	----	2.31	10.01	---	--	591	7.8	-1.51
102	-----	758 -N	4.83	----	2.31	10.04	---	--	593	7.8	-1.48
103	-----	758 -N	5.80	----	2.31	10.14	---	--	597	7.8	-1.39
104	0.004	758 -N	5.80	----	2.52	10.24	---	--	602	8.1	-1.29
105	0.052	758 -S	0.20	27.6	4.03	10.76	---	--	629	8.1	-1.47
106	0.207	758 -S	0.20	26.6	4.03	10.81	---	--	632	8.1	-1.42
107	0.016	758 -S	0.39	27.7	3.95	12.98	---	--	733	8.5	+0.75
108	0.008	758 -S	0.39	----	3.95	12.99	---	--	734	8.5	+0.76
109	0.002	758 -S	0.58	----	2.88	13.05	---	--	726	8.6	0.84
110	0.002	758 -S	0.58	----	2.88	13.02	---	--	725	8.6	0.81
111	-----	758 -S	0.97	----	2.88	12.96	---	--	721	8.6	0.75
112	-----	758 -S	0.97	----	2.83	12.93	---	--	719	8.5	0.72
113	0.017	758 -S	1.46	21.2	2.83	12.76	---	--	712	8.5	0.56
114	-----	758 -S	1.46	----	2.83	12.75	---	--	711	8.5	0.55
115	-----	758 -S	1.95	----	2.98	12.57	---	--	702	8.8	0.37
116	0.002	758 -S	1.95	----	2.98	12.54	---	--	700	8.8	+0.34
117	0.008	758 -S	2.92	----	1.96	11.87	---	--	669	9.2	-0.32
118	0.005	758 -S	2.92	----	1.96	11.83	---	--	667	9.2	-0.36
119	0.003	758 -S	3.90	----	1.96	11.77	---	--	664	9.2	-0.42
120	0.025	758 -S	3.90	----	2.17	11.75	---	--	663	8.9	-0.44
121	0.028	758 -S	4.87	----	2.04	11.44	---	--	649	8.6	-0.75
122	0.014	758 -S	4.87	----	2.04	11.40	---	--	647	8.6	-0.79
123	0.013	758 -S	5.85	----	1.97	10.95	---	--	628	9.0	-1.23
124	0.029	758 -S	5.85	15.7	1.97	10.93	---	--	627	9.0	-1.25

[1]No data.

Table A-2. Suspended-sand sampling data, Nags Head, North Carolina April 1964.-Continued

1 Sample No.	2 C (°/oo)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
125	0.011	758 -S	6.82	---[1]	2.01	10.76	---	--	620	8.9	-1.42
126	0.041	758 -S	6.82	14.0	2.01	10.69	---	--	617	8.9	-1.49
127	2.899	758 -S	0.20	15.6	2.55	10.61	---	--	613	8.8	-1.57
128	-----	758 -S	0.20	12.9	2.55	10.58	---	--	612	8.8	-1.60
129	0.126	758 -S	0.39	21.9	2.22	10.52	---	--	606	8.8	-1.66
130	0.304	758 -S	0.39	20.9	2.22	10.49	---	--	608	8.8	-1.68
131	0.103	758 -S	0.58	22.1	2.18	10.45	---	--	606	8.8	-1.72
132	0.070	758 -S	0.58	21.4	2.18	10.42	---	--	605	8.8	-1.75
133	0.055	758 -S	0.97	22.6	3.19	10.38	---	--	602	8.8	-1.79
134	0.054	758 -S	0.97	21.6	3.19	10.38	---	--	602	8.8	-1.79
135	0.026	758 -S	1.46	23.0	2.83	10.40	---	--	603	8.7	-1.77
136	0.031	758 -S	1.46	22.5	2.82	10.40	---	--	603	8.7	-1.77
137	0.509	300 -N	0.19	----	3.22	4.97	---	--	150	7.9	-0.23
138	1.425	300 -N	0.19	23.2	3.08	5.06	---	--	151	8.1	-0.12
139	0.532	300 -N	0.39	23.1	3.08	5.18	---	--	144	8.1	0.00
140	0.306	300 -N	0.39	23.5	3.08	5.20	---	--	154	8.1	+0.02
141	0.196	300 -N	0.58	24.5	3.93	5.32	---	--	156	8.6	0.16
142	0.083	300 -N	0.58	23.5	3.93	5.39	---	--	158	8.6	0.23
143	0.146	300 -N	0.78	22.8	2.64	5.49	---	--	159	8.3	0.34
144	0.105	300 -N	0.78	23.7	2.64	5.52	---	--	160	8.3	0.38
145	0.263	300 -N	0.97	23.4	3.02	5.74	---	--	164	8.5	0.61
146	0.154	300 -N	0.97	23.3	3.02	5.78	---	--	165	8.5	0.66
147	0.110	300 -N	1.46	22.6	3.02	5.87	---	--	166	8.5	0.76
148	0.194	300 -N	1.46	22.0	2.96	5.94	---	--	167	8.2	0.84
149	0.296	300 -N	1.94	22.5	2.96	5.97	---	--	168	8.2	0.88
150	0.150	300 -N	1.94	21.6	----	5.98	---	--	168	----	0.90
151	0.097	300 -N	2.43	22.7	2.48	6.05	---	--	169	8.8	+0.98
152	0.263	300 -N	2.43	21.4	2.48	6.06	---	--	170	8.8	0.99
153	0.186	300 -N	2.91	20.1	2.76	6.05	---	--	169	9.3	1.00
154	0.085	300 -N	2.91	19.4	2.76	6.04	---	--	169	9.3	0.99
155	0.147	300 -N	0.19	24.4	2.76	6.02	---	--	169	9.3	0.98
156	0.179	300 -N	0.19	23.7	2.76	6.01	---	--	169	9.3	0.97
157	0.131	300 -N	0.39	23.5	2.99	5.96	---	--	168	8.6	0.94
158	0.247	300 -N	0.39	22.6	2.99	5.95	---	--	168	8.6	+0.93
159	0.356	300 -N	0.19	16.9	1.61	4.15	---	--	138	8.5	-0.70
160	0.161	300 -N	0.19	14.3	1.61	4.09	---	--	137	8.5	-0.76
161	0.148	300 -N	0.39	17.1	1.61	4.01	---	--	135	8.5	-0.83
162	0.207	300 -N	0.39	----	1.61	3.92	---	--	134	8.5	-0.92
163	-----	300 -N	0.58	----	2.61	3.80	---	--	132	8.8	-1.02
164	-----	300 -N	0.58	----	2.61	3.79	---	--	132	8.8	-1.03
165	1.353	325 -S	0.19	23.0	2.40	3.48	---	--	150	4.4	-0.80
166	1.429	325 -S	0.19	22.1	2.40	3.49	---	--	150	4.4	-0.79
167	1.036	325 -S	0.39	22.9	2.72	3.62	---	--	152	6.7	-0.65
168	0.783	325 -S	0.39	22.1	2.72	3.66	---	--	152	6.7	-0.61
169	1.552	325 -S	0.58	23.5	4.18	4.15	---	--	159	5.0	-0.08
170	1.183	325 -S	0.58	22.2	4.18	4.19	---	--	160	5.0	-0.04
171	0.672	325 -S	0.77	22.6	4.18	4.25	---	--	161	5.0	+0.03
172	0.915	325 -S	0.77	22.0	3.54	4.31	---	--	161	5.3	0.09
173	0.818	325 -S	0.97	22.3	3.54	4.45	---	--	163	5.3	0.24
174	0.689	325 -S	0.97	21.5	3.51	4.47	---	--	163	5.1	0.26
175	0.515	325 -S	1.45	21.8	3.51	4.57	---	--	166	5.1	0.37
176	0.736	325 -S	1.45	20.7	3.51	4.59	---	--	165	5.1	+0.39
177	0.876	325 -S	1.93	21.5	----	4.67	---	--	166	---	0.48
178	0.620	325 -S	1.93	20.4	----	4.69	---	--	167	---	0.50
179	0.481	325 -S	2.42	20.8	2.95	4.82	---	--	169	5.4	0.64
180	0.409	325 -S	2.42	19.9	2.95	4.83	---	--	169	5.4	0.65
181	0.392	325 -S	2.90	16.2	2.99	4.86	---	p	169	5.5	0.69
182	0.547	325 -S	2.90	15.9	2.99	4.87	---	p	169	5.5	0.70
183	3.343	325 -S	0.19	22.4	3.00	4.93	---	p	170	5.4	0.78
184	3.228	325 -S	0.19	23.1	3.00	4.94	---	--	170	5.4	0.79
185	1.463	354 -N	0.20	21.3	2.57	5.43	---	--	193	5.5	0.47
186	3.159	354 -N	0.20	20.6	2.57	5.40	---	--	192	5.5	0.45

[1]No data.

Table A-2. Suspended-sand sampling data, Nags Head, North Carolina April 1964.-Continued

1 Sample No.	2 C ($^{o}/oo$)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_e (ft)	11 T_e (s)	12 Tide (ft)
187	0.921	354 -N	0.39	20.0	2.08	5.29	--[1]	--	190	5.5	0.34
188	0.623	354 -N	0.39	20.0	2.08	5.29	---	--	190	5.5	+0.34
189	1.000	354 -N	0.59	20.2	2.08	4.80	---	--	183	5.5	-0.13
190	0.894	354 -N	0.59	19.4	2.08	4.78	---	--	182	5.5	-0.15
191	1.125	354 -N	0.78	19.8	1.86	4.59	---	--	179	5.4	-0.33
192	0.933	354 -N	0.78	18.7	1.86	4.57	---	--	178	5.4	-0.35
193	0.927	354 -N	0.98	18.4	1.86	4.52	---	--	177	5.4	-0.40
194	0.684	354 -N	0.98	12.9	1.86	4.49	---	--	176	5.4	-0.43
195	1.502	354 -N	0.20	18.8	1.65	4.23	---	--	171	5.5	-0.68
196	1.285	354 -N	0.20	17.4	1.65	4.21	---	--	170	5.5	-0.70
197	1.178	354 -N	0.39	18.8	1.40	4.07	---	--	168	5.5	-0.83
198	1.441	354 -N	0.39	16.9	1.40	4.05	---	--	167	5.5	-0.85
199	0.681	354 -N	0.59	18.6	2.20	3.91	---	--	165	5.8	-0.98
200	1.568	354 -N	0.59	16.8	2.20	3.86	---	--	164	5.8	-1.03
201	0.703	354 -N	0.78	16.9	1.65	3.75	---	--	162	5.8	-1.14
202	0.425	354 -N	0.78	16.2	1.65	3.74	---	--	162	5.8	-1.15
203	1.101	354 -N	0.20	22.2	1.65	3.62	---	--	160	5.8	-1.26
204	1.714	354 -N	0.20	13.8	1.64	3.60	---	--	160	6.0	-1.28
205	0.692	354 -N	0.39	19.6	1.49	3.53	---	--	158	9.9	-1.35
206	1.613	354 -N	0.39	18.1	1.49	3.51	---	--	158	9.9	-1.37
207	1.438	354 -N	0.39	19.2	1.49	3.50	---	--	158	9.9	-1.37
208	1.200	354 -N	0.39	18.4	1.72	3.47	---	--	157	5.0	-1.40
209	0.728	354 -N	0.39	17.3	1.72	3.41	---	--	156	5.0	-1.46
210	0.456	326 -N	0.20	16.2	1.85	2.33	---	--	113	9.1	-1.08
211	2.181	326 -N	0.20	12.9	1.85	2.34	---	--	114	9.1	-1.07
212	1.464	326 -N	0.39	21.1	1.85	2.43	---	--	115	9.1	-0.98
213	0.923	326 -N	0.39	20.0	1.75	2.44	---	--	115	8.8	-0.97
214	0.710	326 -N	0.59	21.3	1.75	2.55	---	--	118	8.8	-0.86
215	0.865	326 -N	0.59	20.0	1.70	2.58	---	--	118	9.1	-0.83
216	0.765	326 -N	0.78	21.7	1.65	2.66	---	--	120	9.3	-0.75
217	0.147	326 -N	0.78	20.9	1.65	2.72	---	--	122	9.3	-0.69
218	0.288	326 -N	0.98	22.1	1.82	2.76	---	--	123	9.3	-0.65
219	0.537	326 -N	0.98	20.6	1.82	2.77	---	--	123	9.3	-0.64
220	0.200	326 -N	1.47	21.5	1.08	2.97	---	--	130	9.1	-0.44
221	0.259	326 -N	1.47	20.3	1.80	3.03	---	--	131	9.1	-0.38
222	0.137	326 -N	1.96	21.0	1.74	3.10	---	--	133	9.3	-0.32
223	0.084	326 -N	1.96	19.7	1.74	3.11	---	--	134	9.3	-0.31
224	1.373	326 -N	0.20	23.4	----	3.23	---	--	137	----	-0.19
225	0.476	326 -N	0.20	22.4	----	3.28	---	--	138	----	-0.14
226	0.512	326 -N	0.39	22.6	1.70	3.34	---	--	139	9.5	-0.08
227	0.784	326 -N	0.39	22.0	1.70	3.39	---	--	140	9.5	-0.03
228	0.368	326 -N	0.59	22.9	1.90	3.51	---	--	142	9.2	+0.09
229	0.550	326 -N	0.59	21.6	1.90	3.54	---	--	142	9.2	0.12
230	0.253	326 -N	0.78	22.7	1.90	3.60	---	--	143	9.2	0.18
231	0.515	326 -N	0.78	21.7	1.90	3.64	---	--	144	9.2	0.22
232	0.158	326 -N	0.98	22.0	1.77	3.73	---	--	146	9.3	0.31
233	0.271	326 -N	0.98	21.4	1.77	3.74	---	--	146	9.3	0.32
234	0.146	326 -N	1.47	21.6	1.68	3.87	---	--	148	9.9	0.45
235	0.148	326 -N	1.47	20.3	1.68	3.87	---	--	148	9.9	0.45
236	0.033	326 -N	1.96	20.9	1.59	3.91	---	--	149	8.8	0.49
237	0.294	326 -N	1.96	19.6	1.59	3.92	---	--	149	9.8	0.50
238	1.206	326 -N	0.39	21.9	1.57	3.94	---	--	150	9.3	0.52
239	0.951	326 -N	0.39	21.5	1.57	3.93	---	--	149	9.3	0.51
240	0.688	326 -N	0.39	21.6	1.57	3.90	---	--	149	9.3	0.48
241	0.693	326 -N	0.39	20.5	1.57	3.89	---	--	149	9.3	0.47
242	1.473	325 -N	0.39	19.5	1.53	3.57	---	--	143	10.0	0.18
243	1.992	325 -N	0.39	18.4	1.33	3.44	---	--	140	9.9	+0.05
244	1.548	325 -N	0.39	19.3	1.46	3.34	---	--	139	9.2	-0.05
245	0.993	325 -N	0.39	18.1	1.46	3.33	---	--	139	9.2	-0.06
246	2.372	756 -N	0.20	22.1	1.68	9.80	---	--	566	9.2	-0.27
247	0.651	756 -N	0.20	21.2	1.68	9.63	---	--	559	9.2	-0.43
248	0.059	756 -N	0.49	21.7	1.23	9.51	---	--	555	9.6	-0.55

[1]No data.

Table A-2. Suspended-sand sampling data, Nags Head, North Carolina April 1964.-Continued

1 Sample No.	2 C (‰)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
249	0.006	756 -N	0.49	---[1]	1.23	9.51	---	--	555	9.6	-0.55
250	0.015	756 -N	0.97	----	1.20	9.42	---	--	553	9.8	-0.64
251	-----	756 -N	0.97	----	1.20	9.37	---	--	552	9.8	-0.69
252	-----	756 -N	1.46	----	1.20	9.31	---	--	550	9.8	-0.75
253	-----	756 -N	1.46	----	1.13	9.29	---	--	550	9.6	-0.77
254	-----	756 -N	1.95	----	1.13	9.19	---	--	548	9.6	-0.87
255	-----	756 -N	1.95	----	1.13	9.12	---	--	546	9.6	-0.94
256	0.180	340 -N	0.19	18.7	0.96	2.76	---	--	116	10.0	-1.20
257	0.116	340 -N	0.19	16.8	0.96	2.76	---	--	125	10.0	-1.20
258	0.081	340 -N	0.39	19.1	1.09	2.77	---	--	126	10.1	-1.19
259	0.013	340 -N	0.39	----	1.09	2.77	---	--	126	10.1	-1.19
260	0.062	340 -N	0.58	19.6	1.09	2.77	---	--	126	10.1	-1.19
261	0.113	340 -N	0.58	18.7	1.01	2.77	---	--	126	9.6	-1.19
262	-----	340 -N	0.77	----	1.01	2.79	---	--	126	9.6	-1.17
263	0.031	340 -N	0.77	18.5	1.01	2.84	---	--	127	9.6	-1.13
264	0.085	340 -N	0.97	----	1.02	2.86	---	--	127	9.6	-1.11
265	-----	340 -N	0.97	----	1.02	2.87	---	--	128	9.6	-1.10
266	-----	340 -N	1.45	----	1.02	2.94	---	--	129	9.6	-1.03
267	-----	340 -N	1.45	----	0.81	2.94	---	--	129	9.8	-1.03
268	-----	340 -N	1.93	----	0.81	3.03	---	--	130	9.8	-0.94
269	-----	340 -N	1.93	----	0.82	3.06	---	--	131	9.4	-0.91
270	-----	340 -N	2.42	----	0.82	3.13	---	--	133	9.4	-0.84
271	-----	340 -N	2.42	----	0.82	3.14	---	--	133	9.4	-0.83
272	0.032	340 -N	0.19	22.3	1.18	3.31	---	--	137	10.3	-0.66
273	0.012	340 -N	0.19	----	1.18	3.34	---	--	138	10.3	-0.63
274	0.003	340 -N	0.39	----	----	3.39	---	--	139	----	-0.58
275	0.016	340 -N	0.39	----	----	3.39	---	--	139	----	-0.58
276	-----	340 -N	0.58	----	----	3.49	---	--	142	----	-0.48
277	-----	340 -N	0.58	----	----	3.55	---	--	144	----	-0.42
278	-----	340 -N	0.97	----	0.76	3.67	---	--	149	9.8	-0.30
279	-----	340 -N	0.97	----	0.76	3.70	---	--	150	9.8	-0.27
280	-----	340 -N	1.45	----	1.10	3.77	---	--	151	9.7	-0.20
281	-----	340 -N	1.45	----	1.10	3.78	---	--	152	9.7	-0.19
282	-----	340 -N	1.93	----	1.07	3.91	---	--	154	9.7	-0.06
283	-----	340 -N	1.93	----	1.07	4.91	---	--	154	9.7	-0.06
284	-----	340 -N	2.42	----	1.07	4.04	---	--	157	10.1	+0.07
285	-----	340 -N	2.42	----	1.07	2.05	---	--	157	10.1	+0.08
286	0.394	325 -N	0.20	19.4	1.46	2.65	---	--	118	10.1	-0.88
287	0.277	325 -N	0.20	18.2	1.46	2.61	---	--	117	10.1	-0.92
288	0.139	325 -N	0.39	20.3	1.64	2.54	---	--	116	10.5	-0.99
289	0.090	325 -N	0.39	18.3	1.64	2.53	---	--	115	10.5	-1.00
290	0.100	325 -N	0.58	20.0	0.67	2.47	---	--	114	10.1	-1.06
291	0.091	325 -N	0.58	19.0	0.67	2.46	---	--	114	10.1	-1.07
292	0.030	325 -N	0.78	21.4	0.67	2.44	---	--	113	10.1	-1.09
293	0.034	325 -N	0.78	----	0.70	2.43	---	--	113	10.2	-1.10
294	0.048	325 -N	0.97	20.8	0.70	2.43	---	--	113	10.2	-1.10
295	0.078	325 -N	0.97	19.5	----	2.43	---	--	113	----	-1.10
296	-----	325 -N	1.46	----	----	2.44	---	--	114	----	-1.09
297	-----	325 -N	1.46	----	----	2.45	---	--	114	----	-1.08
298	-----	325 -N	1.95	----	0.52	2.47	---	--	114	10.3	-1.06
299	0.046	325 -N	1.95	19.9	0.52	2.49	---	--	115	10.3	-1.04
300	0.311	325 -N	0.20	20.0	0.55	2.54	---	--	116	10.0	-0.99
301	0.347	325 -N	0.19	20.8	0.55	2.55	---	--	116	10.0	-0.98
302	0.125	325 -N	0.39	21.2	0.56	2.64	---	--	118	10.5	-0.89
303	0.065	325 -N	0.39	20.4	0.56	2.65	---	--	118	10.5	-0.88
304	0.039	325 -N	0.58	22.3	1.16	2.83	---	--	122	10.1	-0.70
305	0.030	325 -N	0.58	21.2	1.16	2.85	---	--	123	10.1	-0.68
306	0.026	325 -N	0.78	21.9	0.96	3.13	---	--	131	5.1	-0.40
307	0.046	325 -N	0.78	20.8	0.96	3.15	---	--	132	5.1	-0.38
308	0.003	325 -N	0.97	----	1.19	3.35	---	--	138	4.7	-0.19
309	0.002	325 -N	0.97	----	1.19	3.40	---	--	139	4.7	-0.14
310	-----	325 -N	1.46	----	1.19	3.49	---	--	141	4.7	-0.05

[1]No data.

Table A-2. Suspended-sand sampling data, Nags Head, North Carolina April 1964.-Continued

1 Sample No.	2 C ($^{0}/oo$)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
311	0.036	325 -N	1.46	22.1	1.14	3.50	--[1]	--	142	5.0	-0.04
312	0.005	325 -N	1.95	----	1.14	3.57	---	--	143	5.0	+0.03
313	0.011	325 -N	1.95	----	1.14	3.60	---	--	145	5.0	0.06
314	-----	325 -N	2.44	----	0.97	3.67	---	--	146	4.8	0.13
315	-----	325 -N	2.44	----	0.97	3.69	---	--	147	4.8	0.15
316	1.274	258 -N	0.19	22.0	1.44	2.54	---	--	84	10.3	0.38
317	2.380	258 -N	0.19	21.2	1.44	2.55	---	--	86	10.3	0.39
318	0.283	258 -N	0.39	21.9	1.20	2.63	---	--	88	10.1	0.47
319	0.498	258 -N	0.39	20.6	1.20	2.64	---	--	89	10.1	0.48
320	0.165	258 -N	0.58	22.3	0.74	2.71	---	--	90	10.4	0.55
321	0.158	258 -N	0.58	21.2	0.74	2.71	---	--	90	10.4	0.55
322	0.076	258 -N	0.77	21.7	1.43	2.77	---	--	92	9.9	0.60
323	0.174	258 -N	0.77	20.3	1.43	2.77	---	--	92	9.9	0.60
324	0.078	258 -N	0.97	21.5	1.07	2.76	---	--	92	11.8	0.59
325	0.112	258 -N	0.97	20.3	1.07	2.76	---	--	92	11.8	0.59
326	0.094	258 -N	1.45	20.6	1.30	2.74	---	--	91	5.3	+0.57
327	0.102	258 -N	1.45	19.9	1.30	2.73	---	--	91	5.3	0.56
328	1.712	258 -N	0.19	23.7	1.30	2.70	---	--	90	5.3	0.53
329	0.751	258 -N	0.19	22.4	0.99	2.69	---	--	90	10.1	+0.52
330	-----	366 -N	0.19	----	1.92	4.99	---	--	172	8.1	-0.40
331	2.944	366 -N	0.19	19.9	1.92	4.98	---	--	172	8.1	-0.41
332	0.247	366 -N	0.39	21.3	1.92	4.85	---	--	168	8.1	-0.54
333	0.375	366 -N	0.39	20.5	1.93	4.84	---	--	167	7.2	-0.55
334	0.469	366 -N	0.58	21.3	1.93	4.72	---	--	164	7.2	-0.67
335	0.319	366 -N	0.58	20.2	2.27	6.70	---	--	164	7.8	-0.69
336	0.223	366 -N	0.77	25.3	2.27	4.50	---	--	159	7.4	-0.90
337	0.271	366 -N	0.77	23.7	2.27	4.28	---	--	159	7.4	-0.92
338	0.026	366 -N	0.97	24.2	2.27	4.41	---	--	157	7.4	-0.99
339	0.208	366 -N	0.97	23.2	2.43	4.40	---	--	157	7.7	-1.00
340	0.074	366 -N	1.45	24.4	2.43	4.34	---	--	156	7.7	-1.06
341	0.083	366 -N	1.45	22.9	----	4.30	---	--	155	----	-1.10
342	0.099	366 -N	1.93	23.0	----	4.26	---	--	154	----	-1.14
343	0.047	366 -N	1.93	22.9	----	4.26	---	--	154	----	-1.14
344	1.073	366 -N	2.42	24.1	1.87	4.24	---	--	153	8.2	-1.16
345	0.087	366 -N	2.42	24.2	1.87	4.22	---	--	152	8.2	-1.18
346	0.148	366 -N	2.90	20.2	2.12	4.21	---	--	152	8.0	-1.19
347	0.097	366 -N	2.90	21.5	2.12	4.21	---	--	152	8.0	-1.19
348	1.474	366 -N	0.19	17.0	2.06	4.20	---	--	152	8.5	-1.20
349	1.477	366 -N	0.19	15.9	2.06	4.20	---	--	152	8.5	-1.20
350	0.207	366 -N	0.39	22.5	1.92	4.21	---	--	152	8.1	-1.19
351	0.015	366 -N	0.39	22.3	1.92	4.22	---	--	152	8.1	-1.18
352	-----	366 -N	0.58	----	2.12	4.23	---	--	153	7.5	-1.17
353	0.040	366 -N	0.58	21.2	2.12	4.26	---	--	153	7.5	-1.15
354	0.127	366 -N	0.77	24.1	2.51	4.74	---	--	164	7.6	-0.67
355	0.200	366 -N	0.77	23.3	2.51	4.81	---	--	166	7.6	-0.60
356	0.193	366 -N	0.97	24.4	2.85	4.89	---	--	169	7.6	-0.52
357	0.211	366 -N	0.97	23.2	2.85	4.90	---	--	169	7.6	-0.50
358	0.035	366 -N	1.45	24.5	2.33	4.98	---	--	171	7.9	-0.43
359	0.066	366 -N	1.45	23.7	2.33	5.06	---	--	174	7.9	-0.35
360	0.035	366 -N	1.93	27.6	2.37	5.33	---	--	182	7.3	-0.09
361	0.026	366 -N	1.93	26.9	2.37	3.36	---	--	183	7.3	-0.06
362	-----	366 -N	2.42	----	2.22	3.52	---	--	188	7.1	+0.10
363	0.051	366 -N	2.42	26.2	2.22	3.53	---	--	188	7.1	0.11
364	0.078	366 -N	2.90	----	2.24	2.65	---	--	192	7.9	0.23
365	-----	366 -N	2.90	----	2.24	2.66	---	--	192	7.9	0.24
366	0.019	366 -N	3.38	----	2.24	2.75	---	--	195	7.9	0.33
367	-----	366 -N	3.38	----	2.29	2.79	---	--	196	7.6	0.37
368	0.064	366 -N	3.86	----	2.29	2.90	---	--	199	7.6	0.48
369	-----	366 -N	3.86	----	2.29	2.90	---	--	199	7.6	0.48
370	1.564	366 -N	0.19	26.8	2.33	5.98	---	--	201	7.0	0.56
371	2.840	366 -N	0.19	26.0	2.33	6.00	---	--	202	7.0	0.58
372	0.310	218 -N	0.20	6.6	2.02	2.10	---	--	60	8.4	0.76

[1]No data.

Table A-2. Suspended-sand sampling data, Nags Head, North Carolina April 1964.-Continued

1 Sample No.	2 C (°/oo)	3 Sta. No.	4 E (ft)	5 V_l (ft/s)	6 H_s (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_s (ft)	11 T_s (s)	12 Tide (ft)
373	0.616	218 -N	0.20	6.3	2.02	2.11	--[1]	--	60	8.4	0.77
374	0.674	218 -N	0.20	24.4	2.02	2.12	---	--	61	8.4	0.78
375	1.606	218 -N	0.20	23.2	2.22	2.13	---	--	61	8.8	0.79
376	0.589	218 -N	0.39	24.1	2.22	2.14	---	--	61	8.8	+0.80
377	0.542	218 -N	0.39	23.2	2.22	2.14	---	--	601	8.8	+0.80
378	1.849	758 -N	0.20	21.4	3.39	9.40	---	--	574	11.4	-0.10
379	1.278	758 -N	0.20	21.2	3.39	9.28	---	--	571	11.4	-0.22
380	0.172	758 -N	0.39	21.9	3.82	9.24	---	--	569	11.9	-0.26
381	0.175	758 -N	0.39	21.2	3.82	9.20	---	--	568	11.9	-0.30
382	0.036	758 -N	0.59	21.4	3.82	9.15	---	--	566	11.9	-0.35
383	0.051	758 -N	0.59	21.1	4.33	9.08	---	--	564	11.8	-0.42
384	0.061	758 -N	0.78	21.5	4.33	9.02	---	--	562	11.8	-0.48
385	0.095	758 -N	0.78	20.4	4.33	8.94	---	--	560	11.8	-0.56
386	0.154	758 -N	0.98	21.7	3.74	8.77	---	--	556	11.4	-0.73
387	0.162	758 -N	0.98	20.5	3.74	8.75	---	--	555	11.4	-0.75
388	0.075	758 -N	1.47	21.5	----	8.64	---	--	553	----	-0.86
389	0.036	758 -N	1.47	----	----	8.64	---	--	553	----	-0.86
390	0.051	758 -N	1.96	21.3	----	8.54	---	--	550	----	-0.96
391	0.087	758 -N	1.96	20.1	----	8.50	---	--	550	----	-1.00
392	0.056	758 -N	2.45	21.4	3.38	8.40	---	--	557	12.0	-1.10
393	0.024	758 -N	2.45	19.9	3.38	8.36	---	--	547	12.0	-1.13
394	0.091	758 -N	2.93	20.8	3.38	8.31	---	--	545	12.0	-1.18
395	0.058	758 -N	2.93	19.6	3.16	8.30	---	--	544	12.2	-1.19
396	------	758 -N	4.90	----	3.16	8.25	---	--	543	11.2	-1.24
397	0.047	758 -N	4.90	19.6	2.56	8.23	---	--	541	11.5	-1.26
398	------	758 -N	7.83	----	2.56	8.21	---	--	541	11.5	-1.27
399	0.065	758 -N	7.83	----	2.56	8.21	---	--	541	11.5	-1.28
400	0.728	758 -N	0.20	22.3	3.20	8.24	---	--	542	11.0	-1.25
401	0.141	758 -N	0.20	21.2	3.20	8.24	---	--	542	11.0	-1.25
402	6.476	486 -N	0.20	24.7	3.62	11.48	---	--	279	12.0	-0.93
403	4.452	486 -N	0.20	23.9	3.62	11.51	---	--	279	12.0	-0.90
404	0.023	486 -N	0.39	26.0	2.73	11.69	---	--	284	11.3	-0.72
405	0.177	486 -N	0.39	24.8	2.73	11.70	---	--	284	11.3	-0.71
406	0.838	486 -N	0.59	----	2.06	11.90	---	--	289	11.8	-0.52
407	0.0366	486 -N	0.59	24.7	2.06	11.92	---	--	290	11.8	-0.50
408	0.0051	486 -N	0.78	----	2.81	14.07	---	--	294	10.9	-0.35
409	0.0339	486 -N	0.78	25.2	2.81	12.08	---	--	295	10.9	-0.34
410	0.0837	486 -N	0.98	26.5	2.83	12.21	---	--	299	11.8	-0.21
411	0.0907	486 -N	0.98	25.2	2.83	12.25	---	--	300	11.8	-0.17
412	0.0180	486 -N	1.47	26.5	3.07	12.47	---	--	304	11.9	+0.05
413	------	486 -N	1.47	----	3.07	12.48	---	--	306	11.9	0.06
414	------	486 -N	1.96	----	3.07	12.57	---	--	311	11.9	0.15
415	0.0118	486 -N	1.96	----	2.81	12.60	---	--	312	11.3	0.18
416	------	486 -N	3.91	----	2.81	12.73	---	--	316	11.3	0.31
417	------	486 -N	3.91	----	2.81	12.77	---	--	317	11.3	0.35
418	------	486 -N	5.87	----	2.81	12.81	---	--	319	11.2	0.39
419	------	486 -N	5.87	----	2.81	12.81	---	--	319	11.2	0.39
420	------	486 -N	12.72	----	2.43	13.01	---	--	326	11.1	0.59
421	------	486 -N	12.72	----	2.43	13.01	---	--	326	11.1	0.59
423	1.809	258 -N	0.20	23.1	2.53	3.19	---	--	83	9.7	0.64
424	0.521	258 -N	0.98	20.7	1.57	2.95	---	--	92	9.8	0.40
426	0.395	258 -N	0.78	21.9	1.44	2.57	---	--	79	9.7	+0.02
427	0.360	258 -N	0.78	20.5	1.44	2.52	---	--	77	9.7	-0.03
428	0.509	258 -N	0.59	21.3	1.21	2.43	---	--	74	9.8	-0.12
429	0.530	258 -N	0.59	20.9	1.21	2.35	---	--	71	9.8	-0.20
430	1.166	258 -N	0.39	21.5	1.21	2.29	---	--	69	9.8	-0.26
431	2.099	258 -N	0.39	20.6	1.46	2.28	---	--	69	9.3	-0.27
432	0.533	258 -N	1.27	20.5	1.46	2.13	---	--	65	9.3	-0.42
433	0.376	258 -N	1.27	19.3	1.34	2.10	---	--	64	9.6	-0.45
434	0.992	320 -N	0.19	20.5	0.81	2.06	---	--	119	9.9	-0.69
435	1.784	320 -N	0.19	19.3	0.81	2.05	---	--	118	9.9	-0.70
436	1.231	320 -N	0.39	21.1	0.81	1.93	---	--	116	9.9	-0.82

[1]No data.

Table A-2. Suspended-sand sampling data, Nags Head, North Carolina April 1964.-Continued

1 Sample No.	2 C ($^o/oo$)	3 Sta. No.	4 E (ft)	5 V_i (ft/s)	6 H_B (ft)	7 d (ft)	8 S (ft)	9 Breaker type	10 S_B (ft)	11 T_B (s)	12 Tide (ft)
437	0.831	320 -N	0.39	18.9	1.62	0.91	--[1]	--	115	9.8	-0.84
438	0.930	320 -N	0.58	20.8	1.62	1.78	---	--	113	9.8	-0.97
439	1.687	320 -N	0.58	20.4	1.57	1.75	---	--	112	9.8	-1.00
440	0.723	320 -N	0.39	20.8	1.57	1.65	---	--	110	9.8	-1.10
441	0.906	320 -N	0.39	19.0	1.57	1.64	---	--	110	9.8	-1.11
442	0.936	320 -N	0.39	18.7	1.43	1.55	---	--	106	9.3	-1.20
443	1.282	320 -N	0.39	19.5	1.43	1.53	---	--	106	9.3	-1.22

[1]No data.

APPENDIX B

BOTTOM PROFILES FOR CITY PIER, VENTNOR, NEW JERSEY, AND JENNETTE'S PIER, NAGS HEAD, NORTH CAROLINA

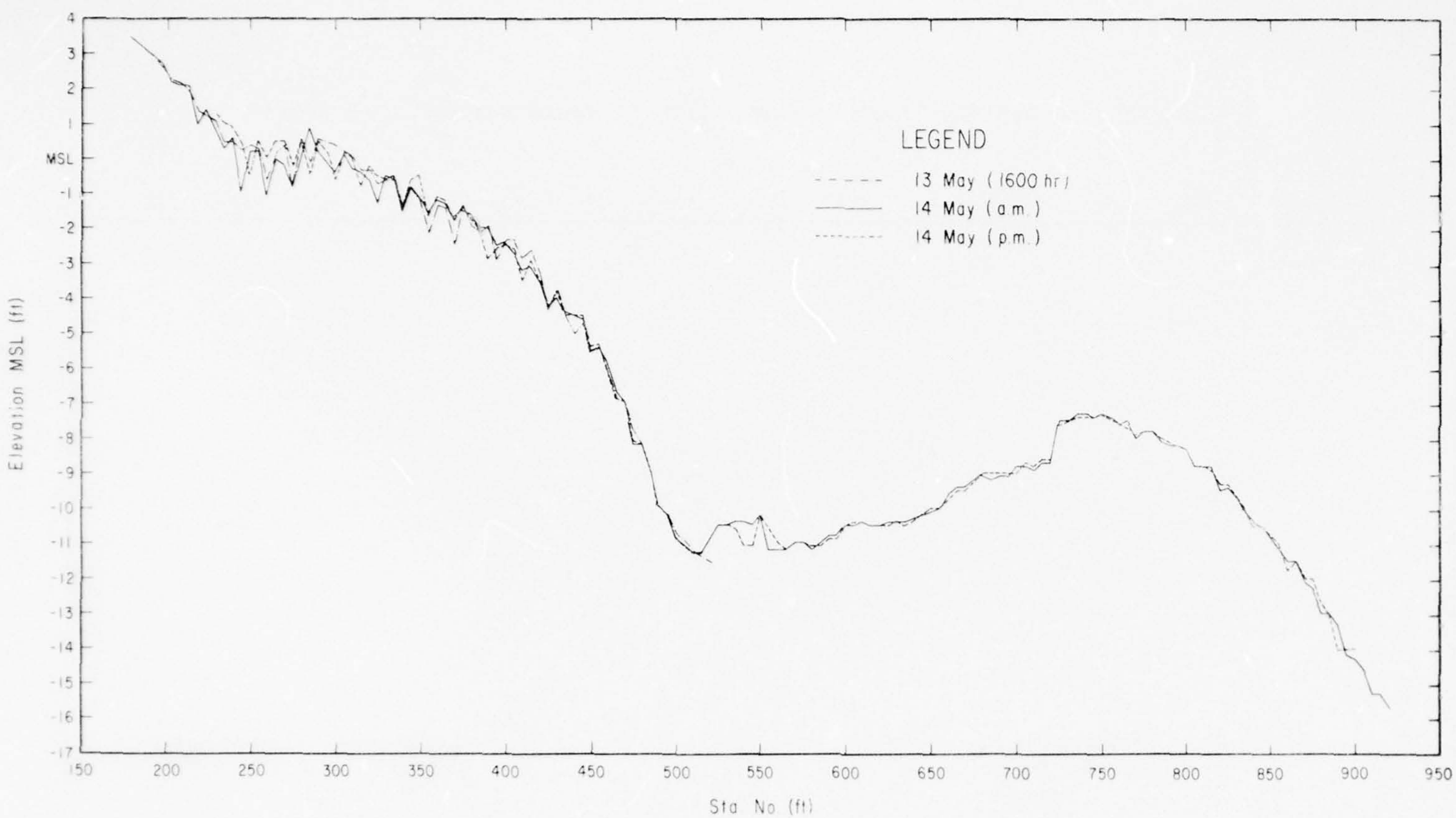

Figure B-1. Bottom profile, City Pier, Ventnor, New Jersey, 13 and 14 May 1965.

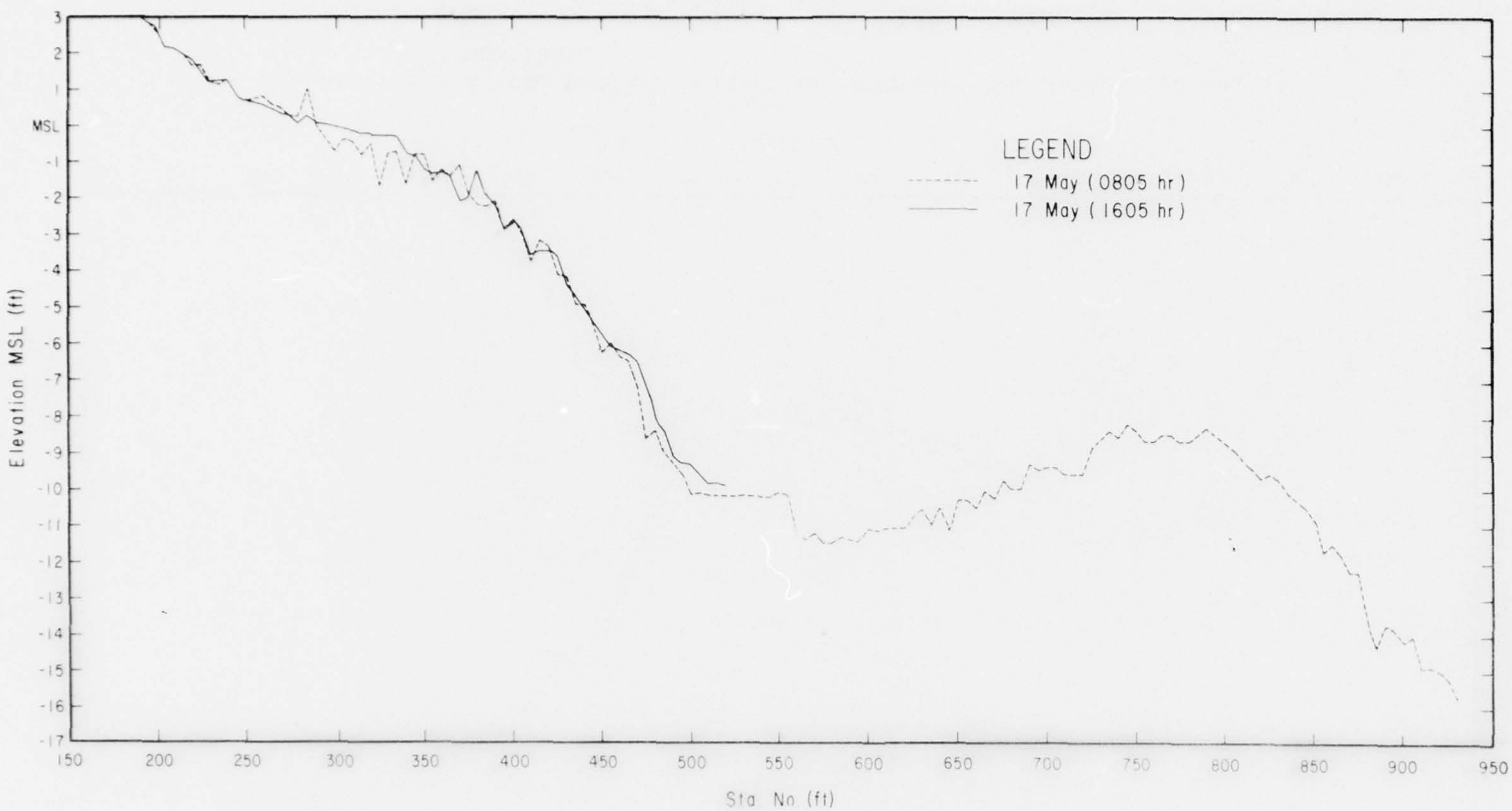

Figure B-2. Bottom profile, City Pier, Ventnor, New Jersey, 17 May 1965.

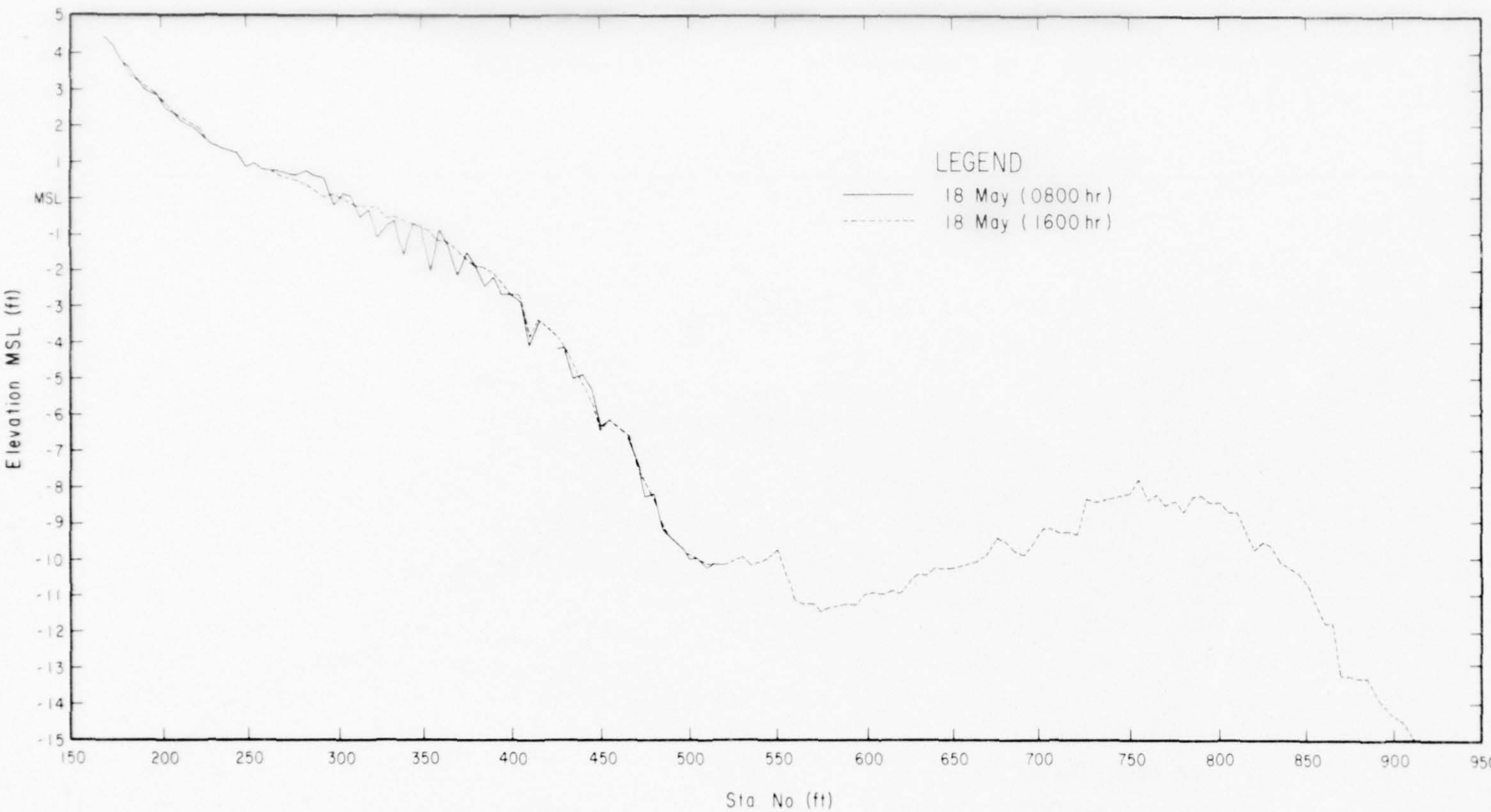

Figure B-3. Bottom profile, City Pier, Ventnor, New Jersey, 18 May 1965.

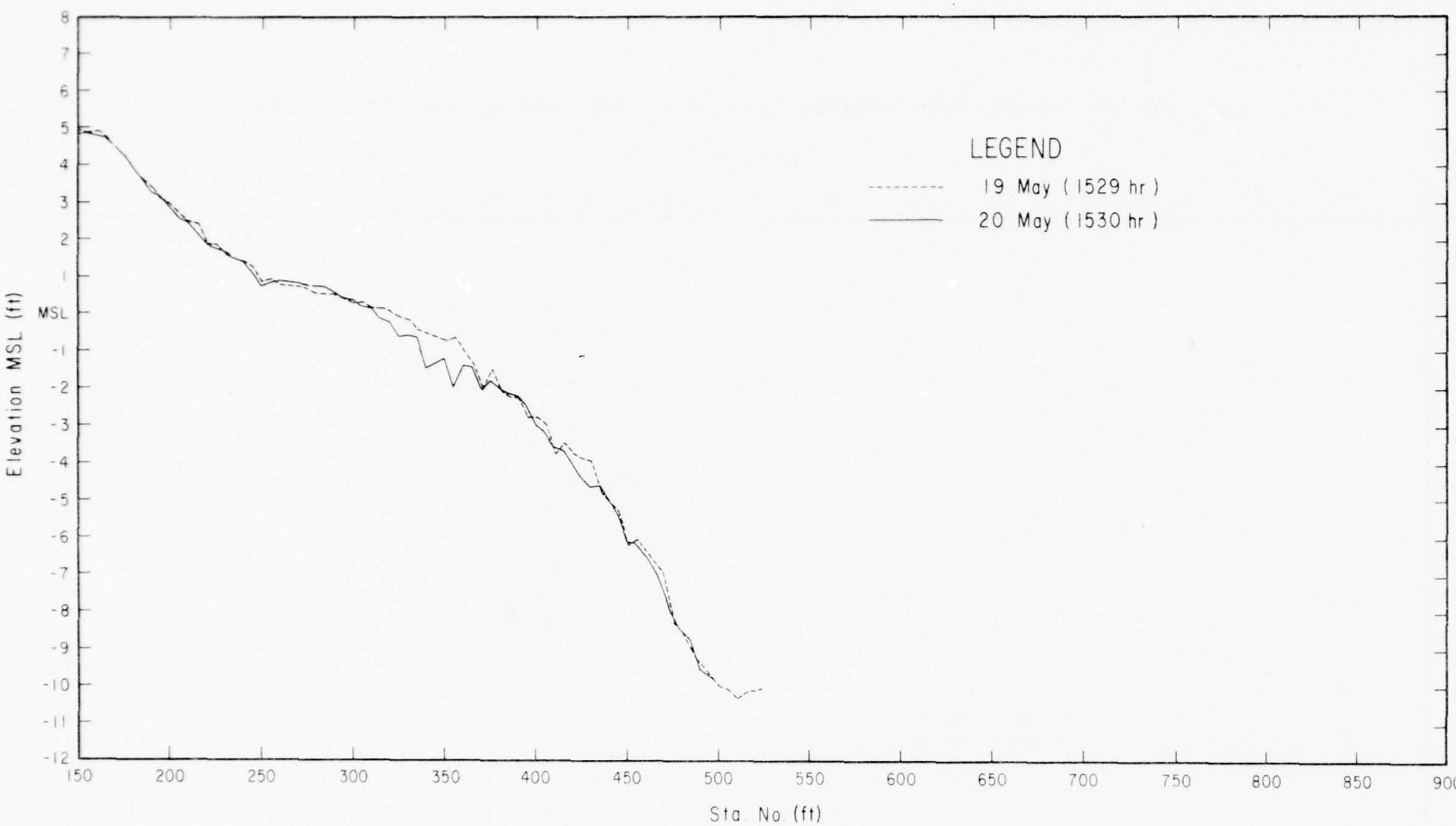

Figure B-4. Bottom profile, City Pier, Ventnor, New Jersey, 19 and 20 May 1965.

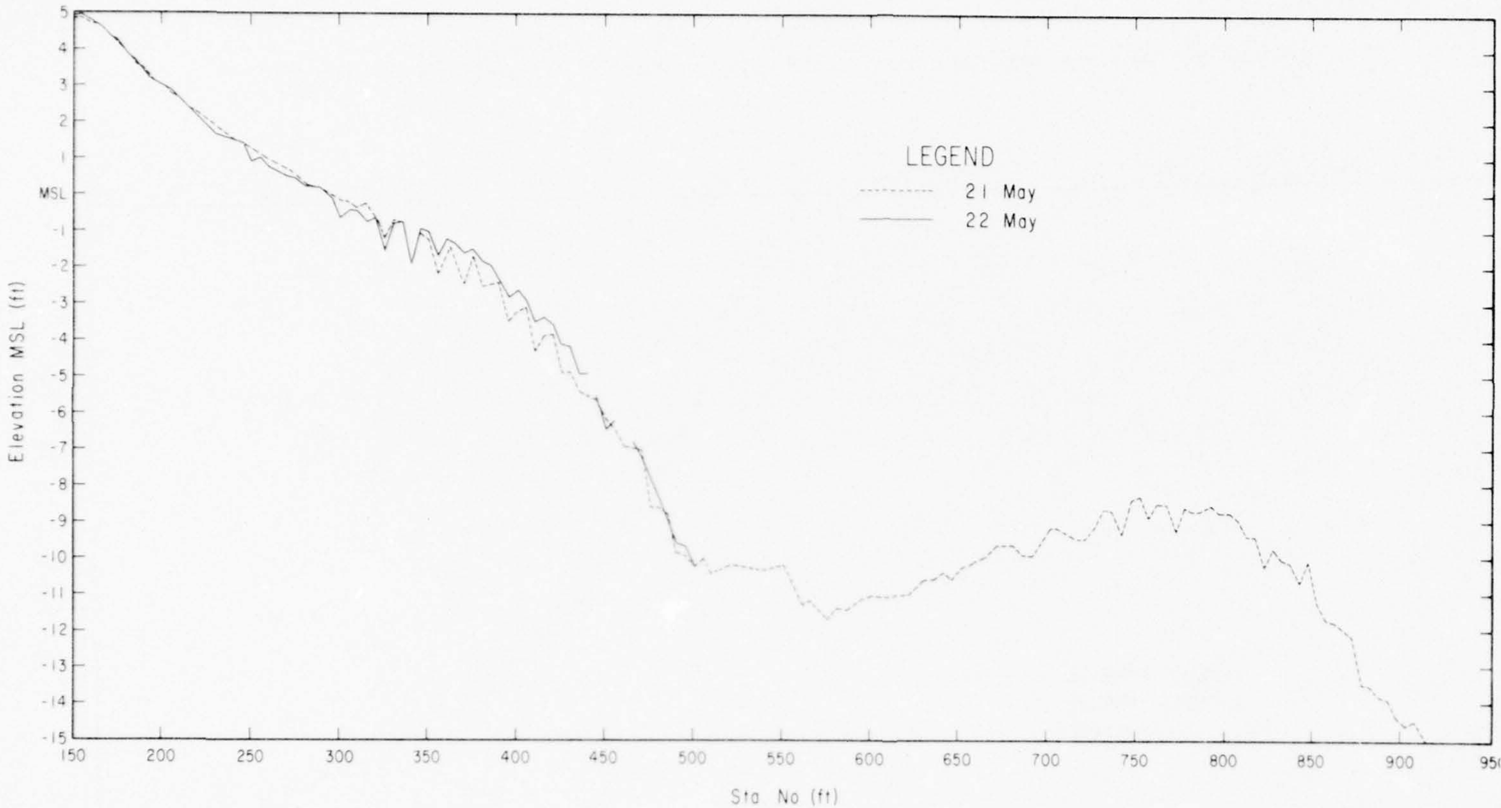

Figure B-5. Bottom profile, City Pier, Ventnor, New Jersey, 21 and 22 May 1965.

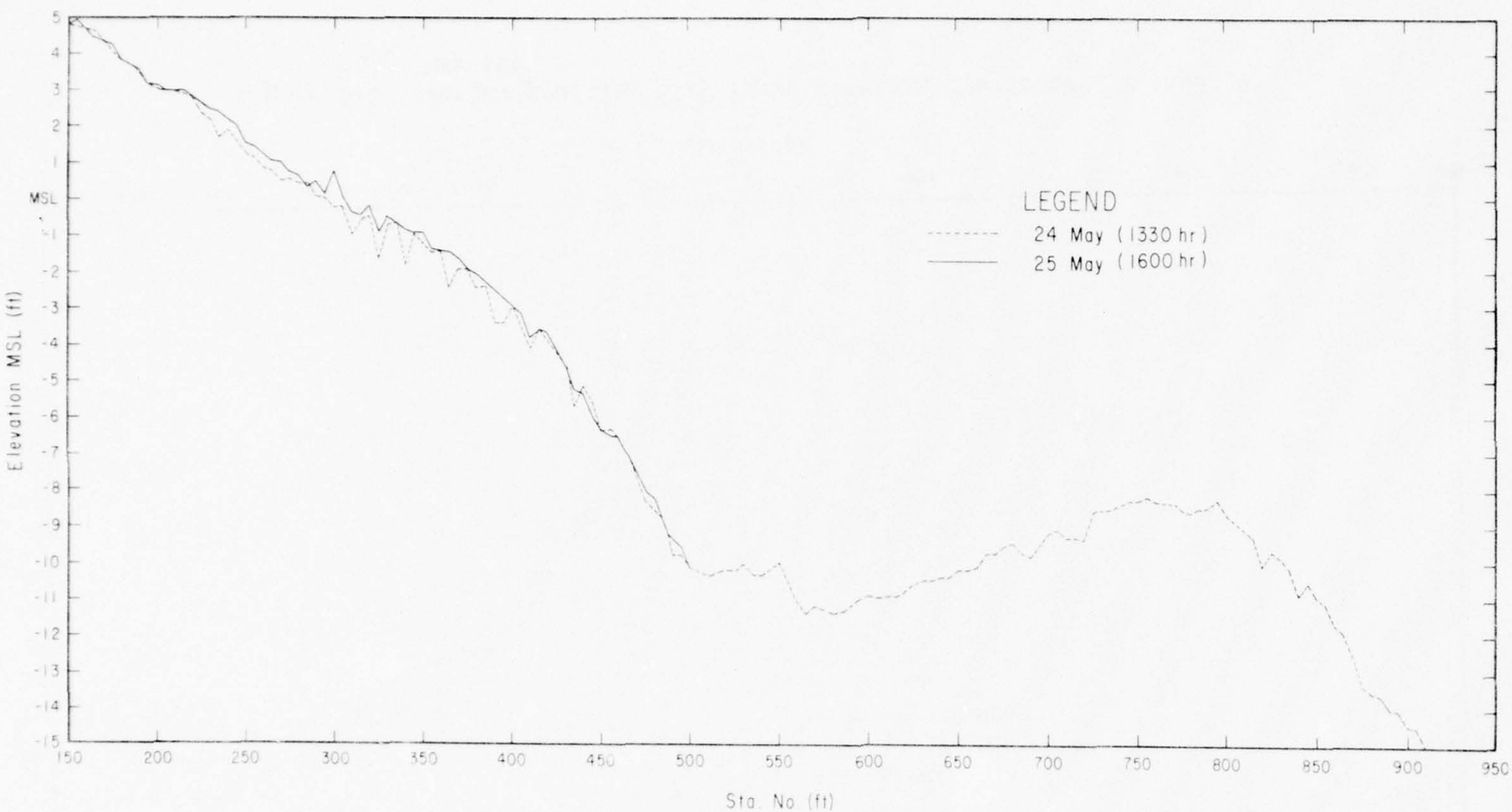

Figure B-6. Bottom profile, City Pier, Ventnor, New Jersey, 24 and 25 May 1965.

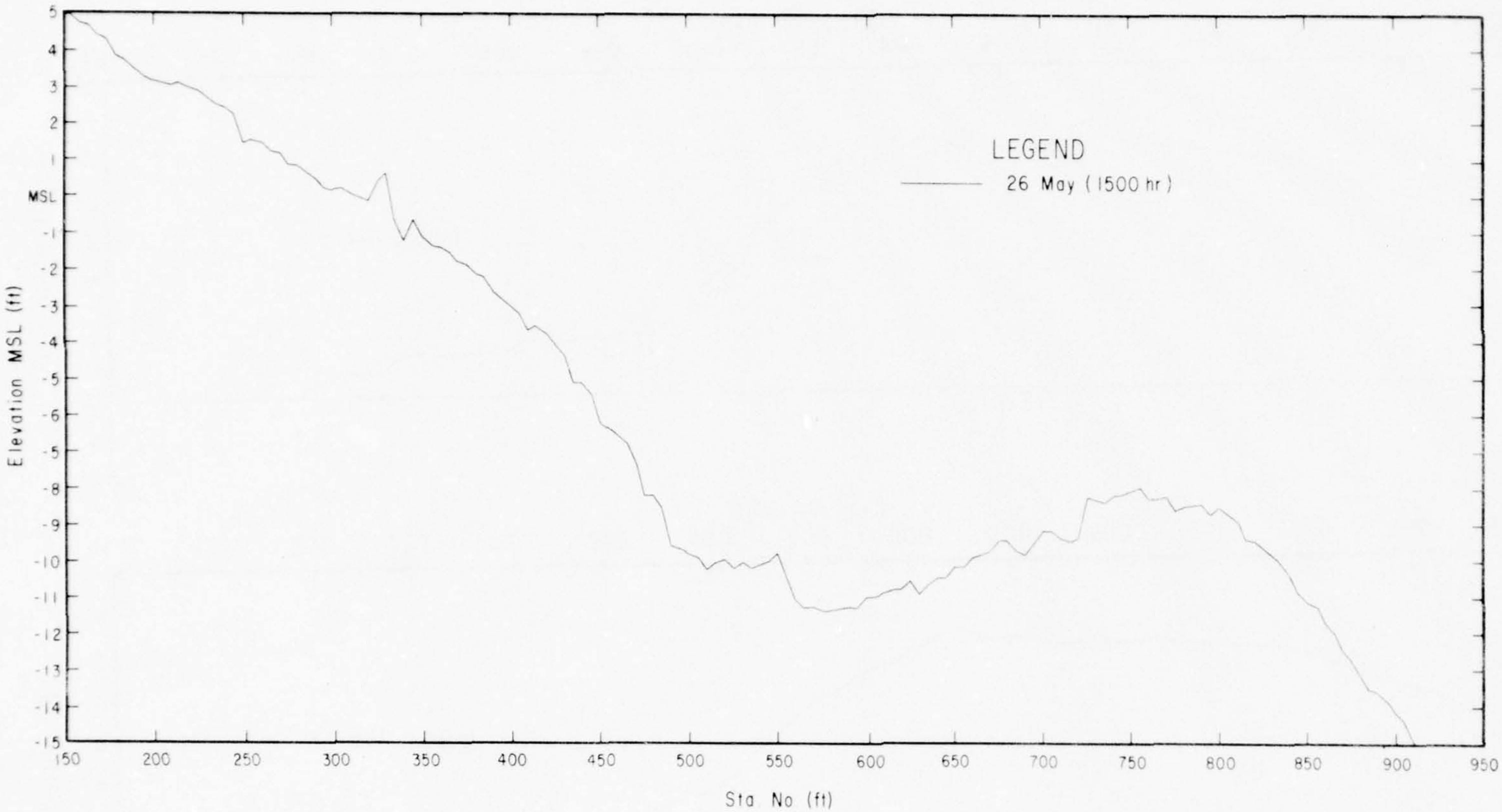

Figure B-7. Bottom profile, City Pier, Ventnor, New Jersey, 26 May 1965.

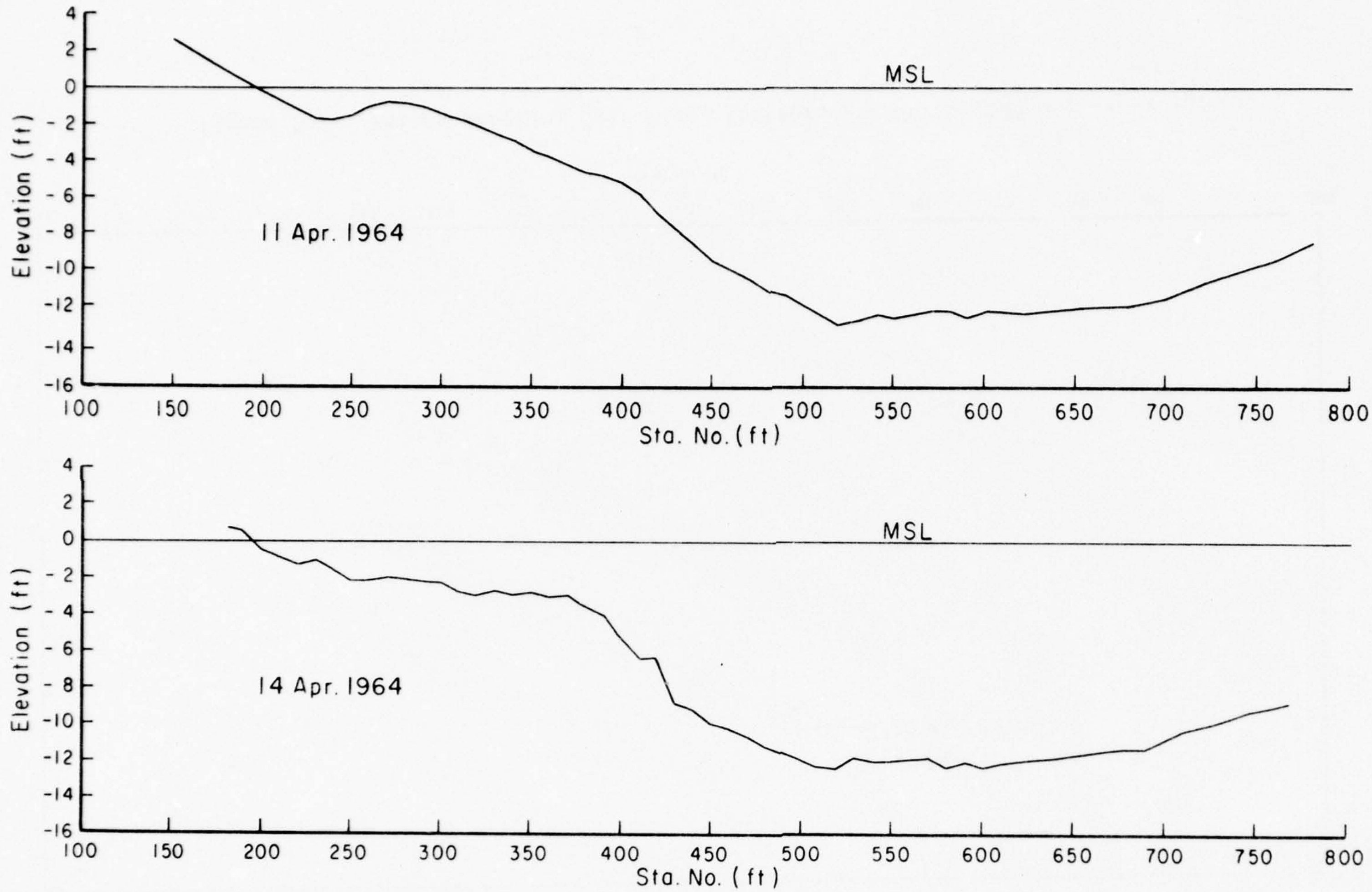

Figure B-8. Bottom profile, Jennette's Pier, Nags Head, North Carolina, 11 and 14 April 1964.

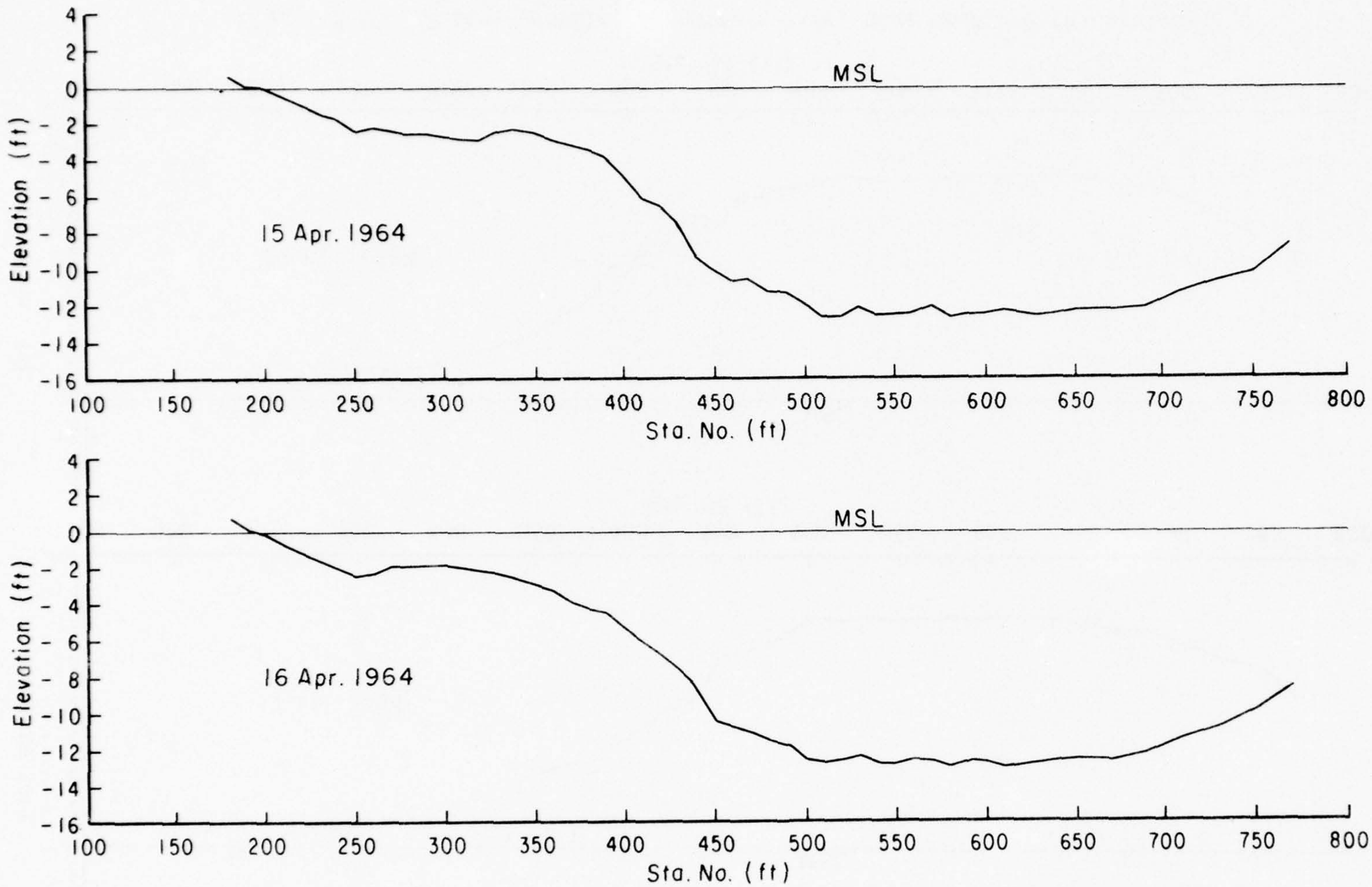

Figure B-9. Bottom profile, Jennette's Pier, Nags Head, North Carolina, 15 and 16 April 1964.

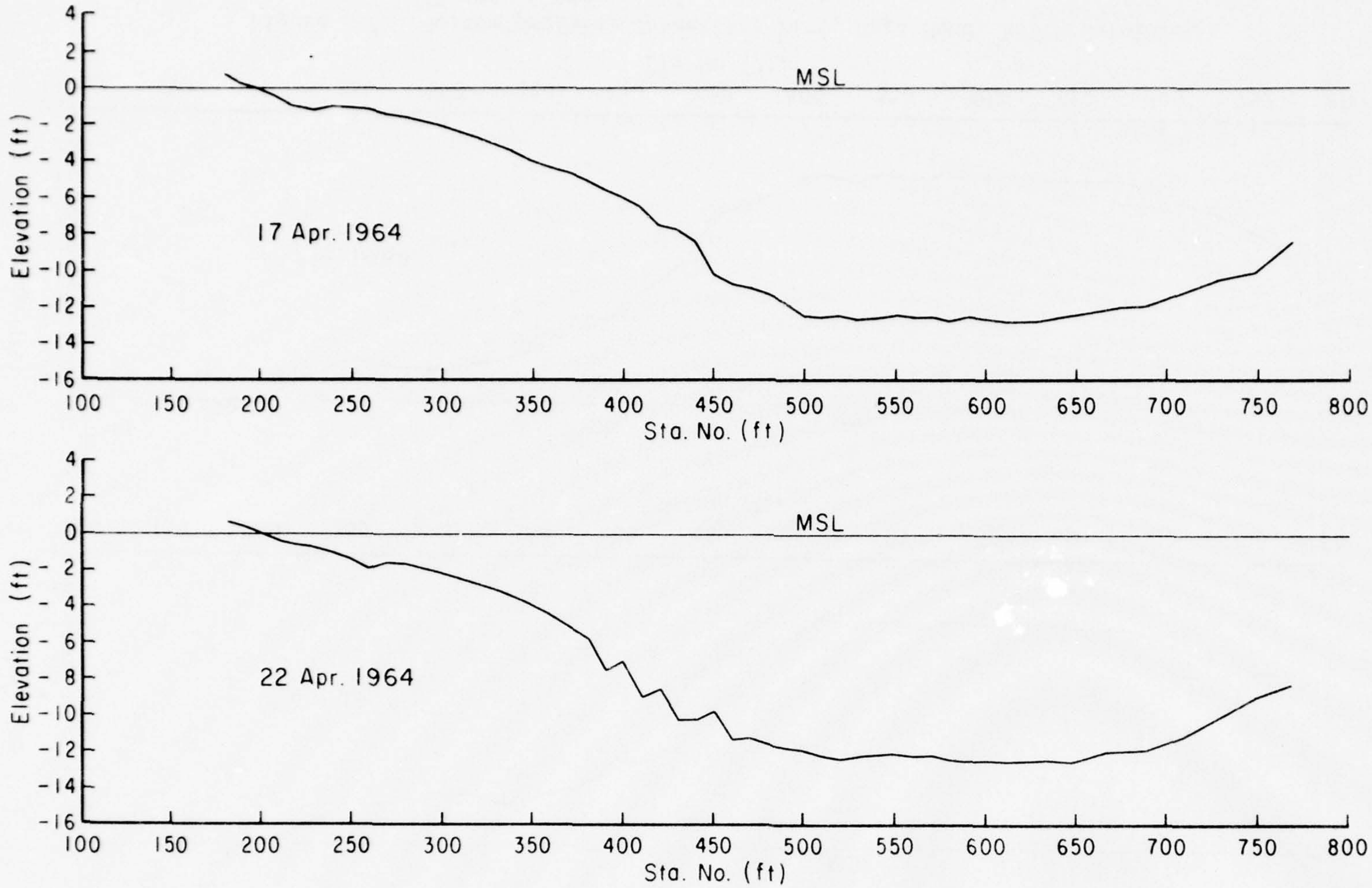

Figure B-10. Bottom profile, Jennette's Pier, Nags Head, North Carolina, 17 and 22 April 1964.

APPENDIX C

TIDE CURVES

Tide curves indicated are for Steel Pier, Atlantic City, New Jersey, 3 miles northeast of the Ventnor City Pier where the sampling collections were made. Tide curves for Jennette's Pier at Nags Head, North Carolina, were interpolated from U.S. Coast and Geodetic Survey tide tables from stations at Hampton Roads and Oregon Inlet.

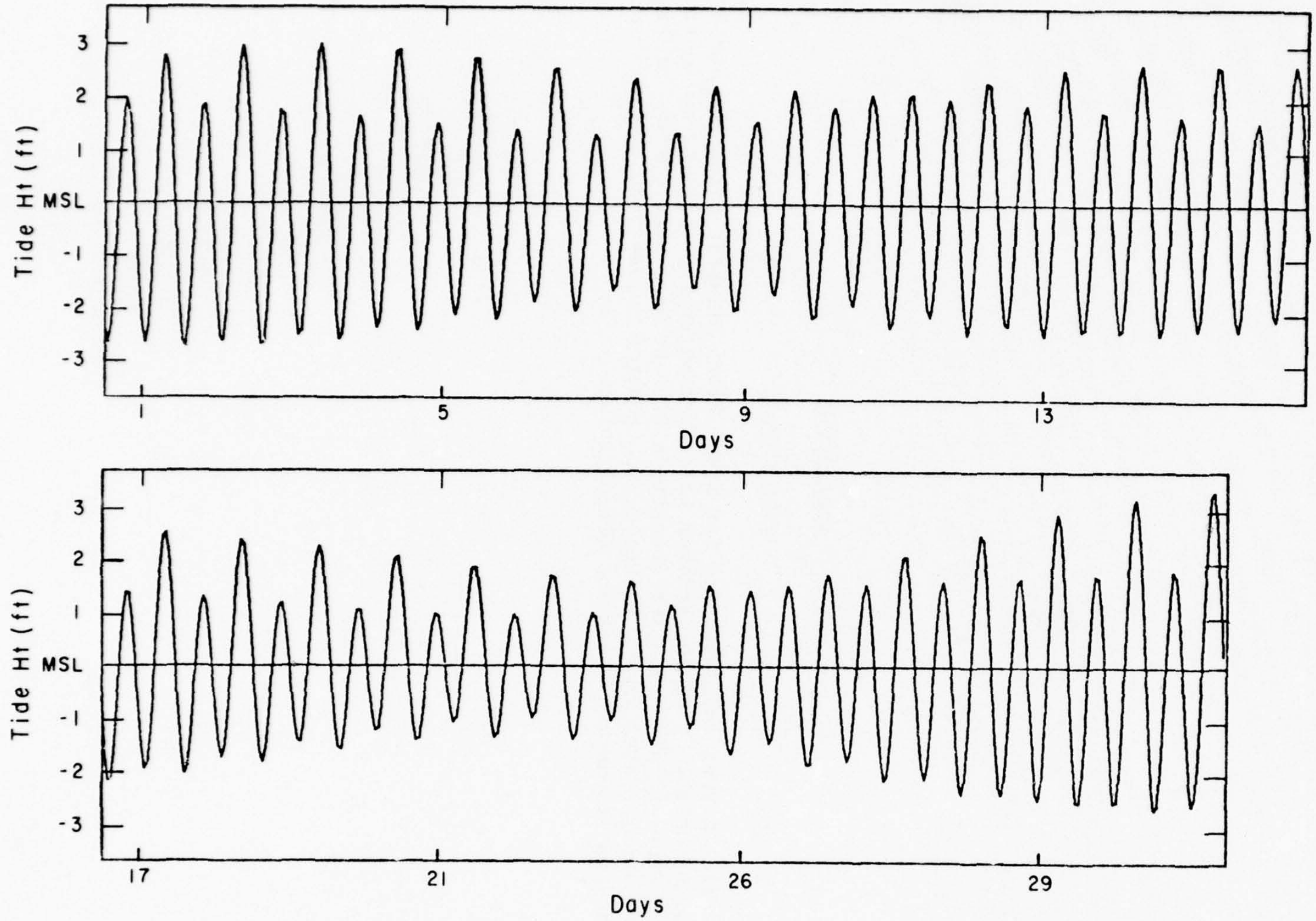

Figure C-1. Predicted tide curves for Steel Pier, Atlantic City, New Jersey, May 1965.

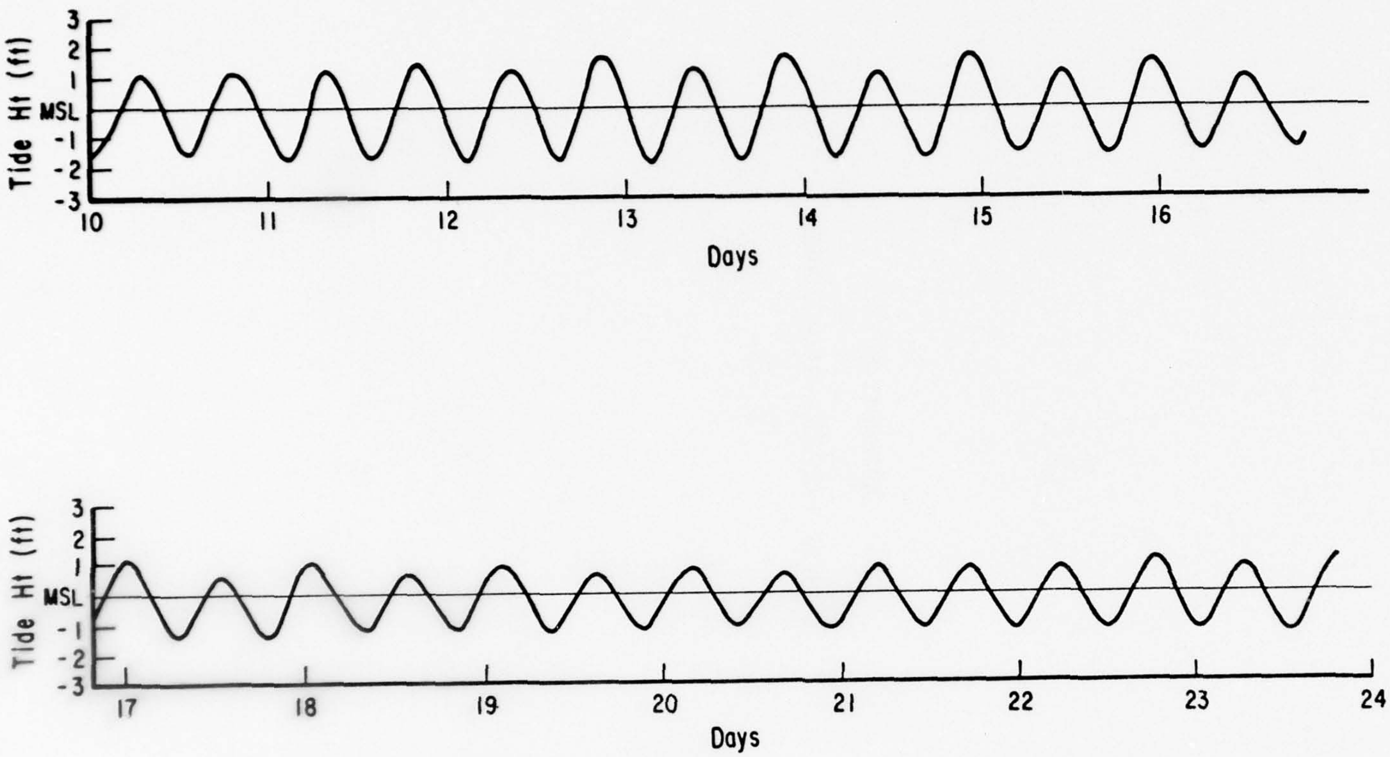

Figure C-2. Interpolated tide curves for Jennette's Pier, Nags Head, North Carolina, April 1964.

APPENDIX D

TYPICAL PARTICLE-SIZE CURVES

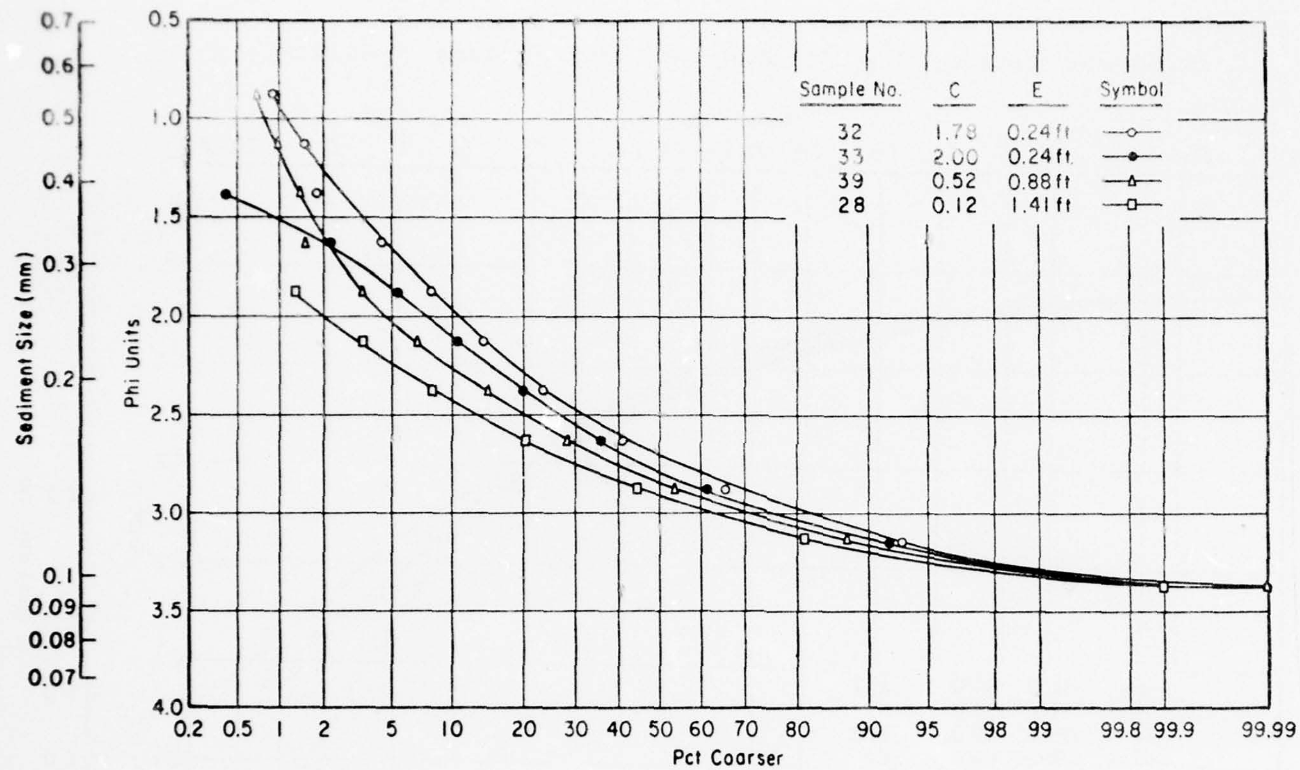

Figure D-1. Range of four nozzle heights, E, Ventnor, New Jersey.

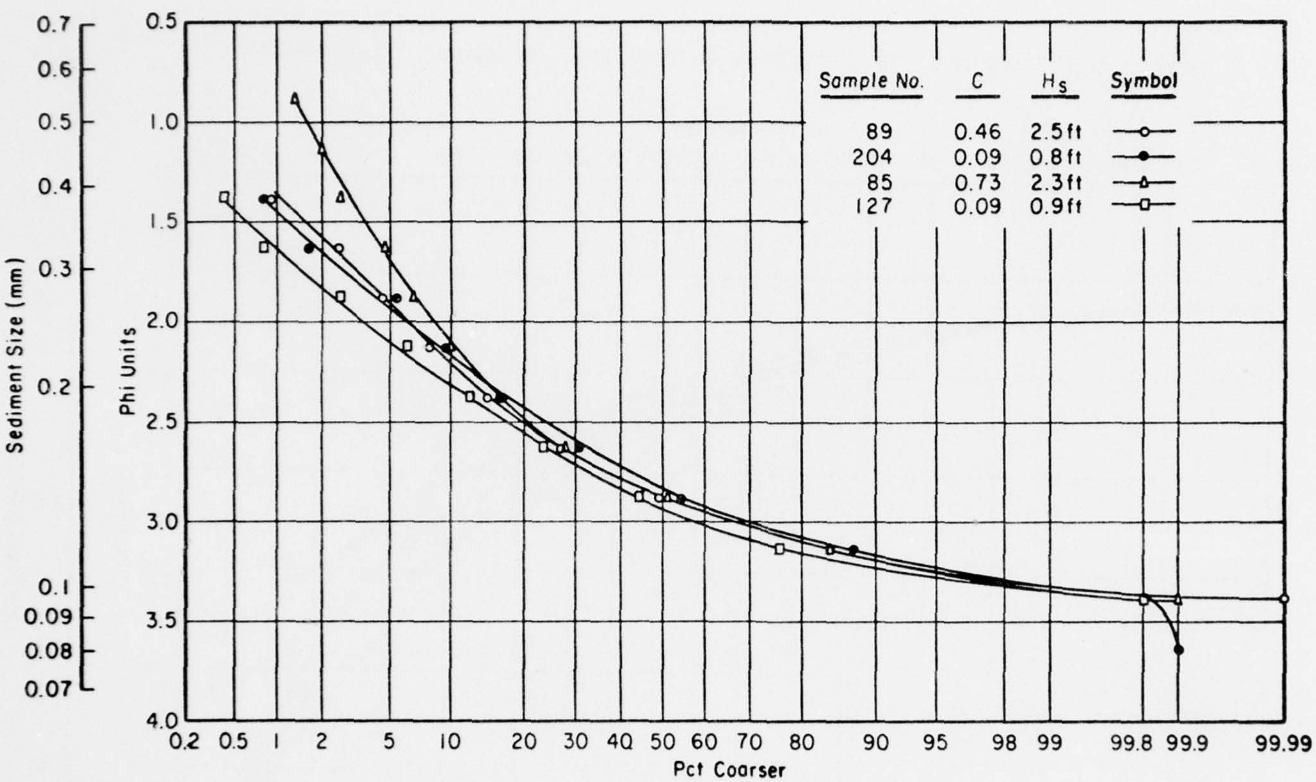

Figure D-2. Range of four wave heights, H_s, Ventnor, New Jersey.

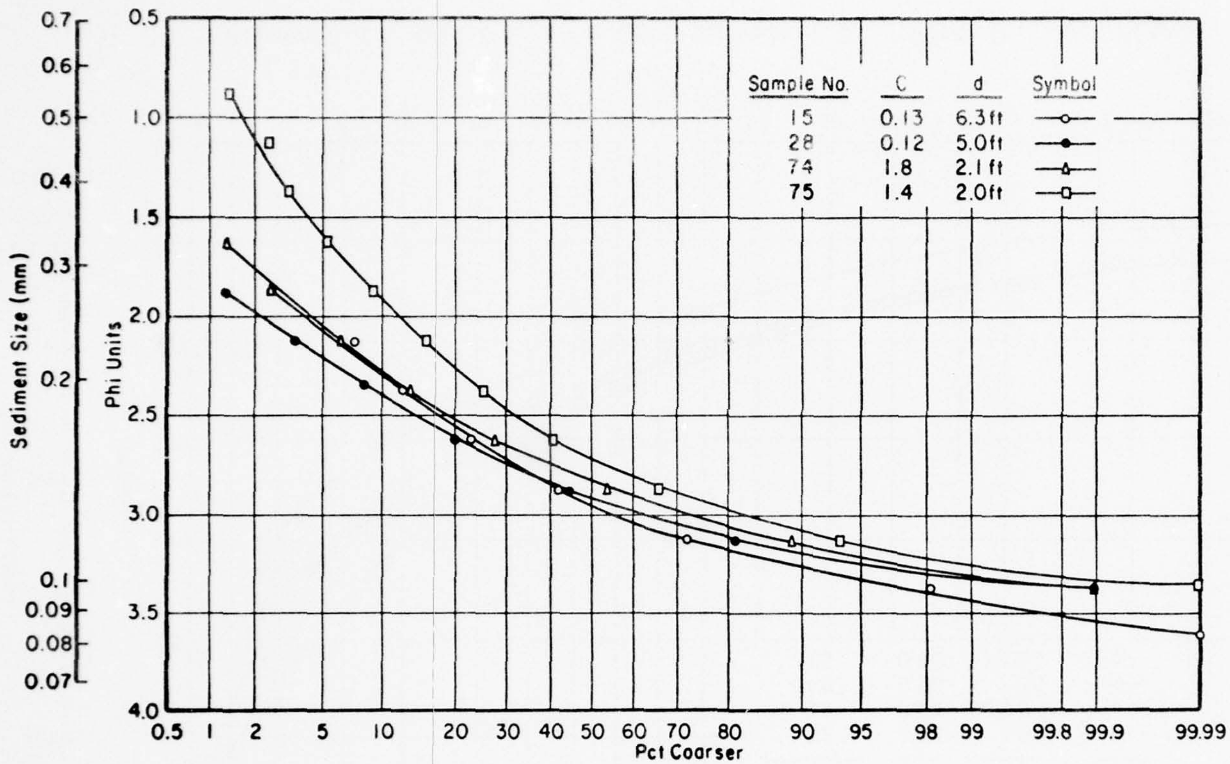

Figure D-3. Range of four water depths, d, Ventnor, New Jersey.

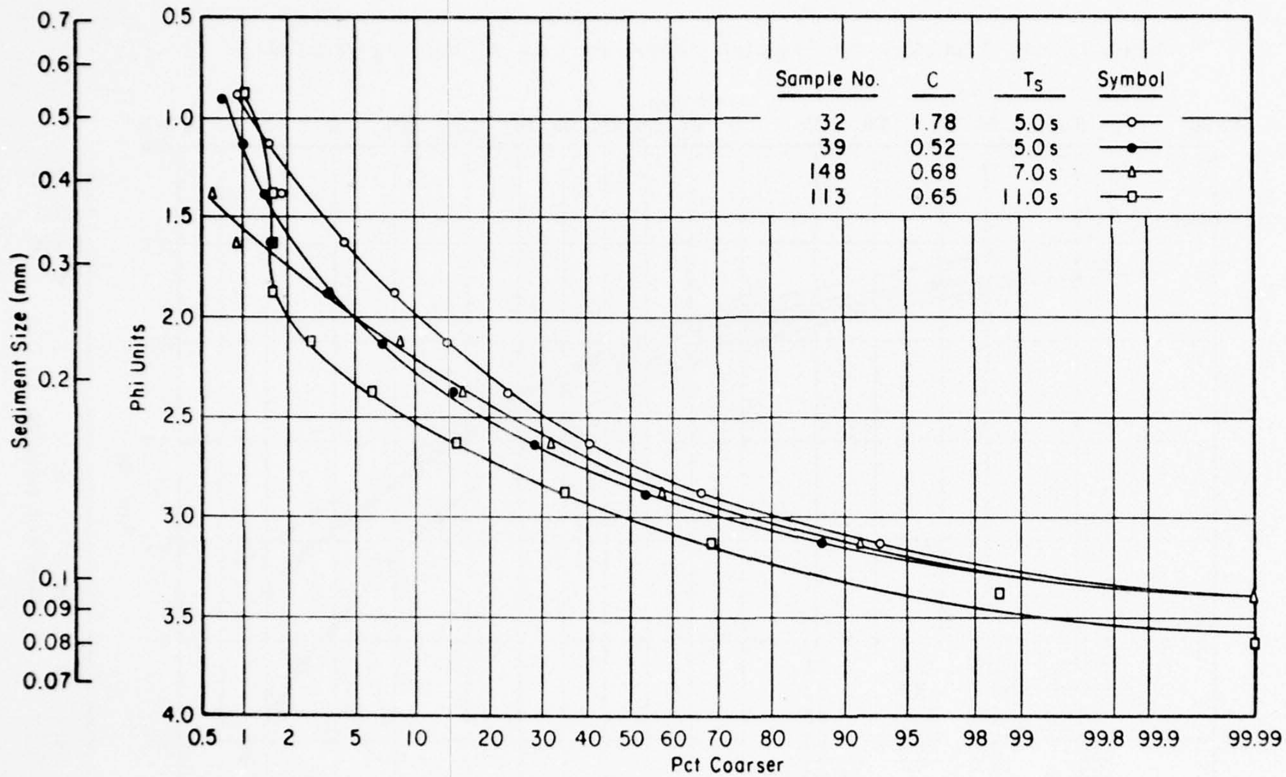

Figure D-4. Range of four wave periods, T_s, Ventnor, New Jersey.

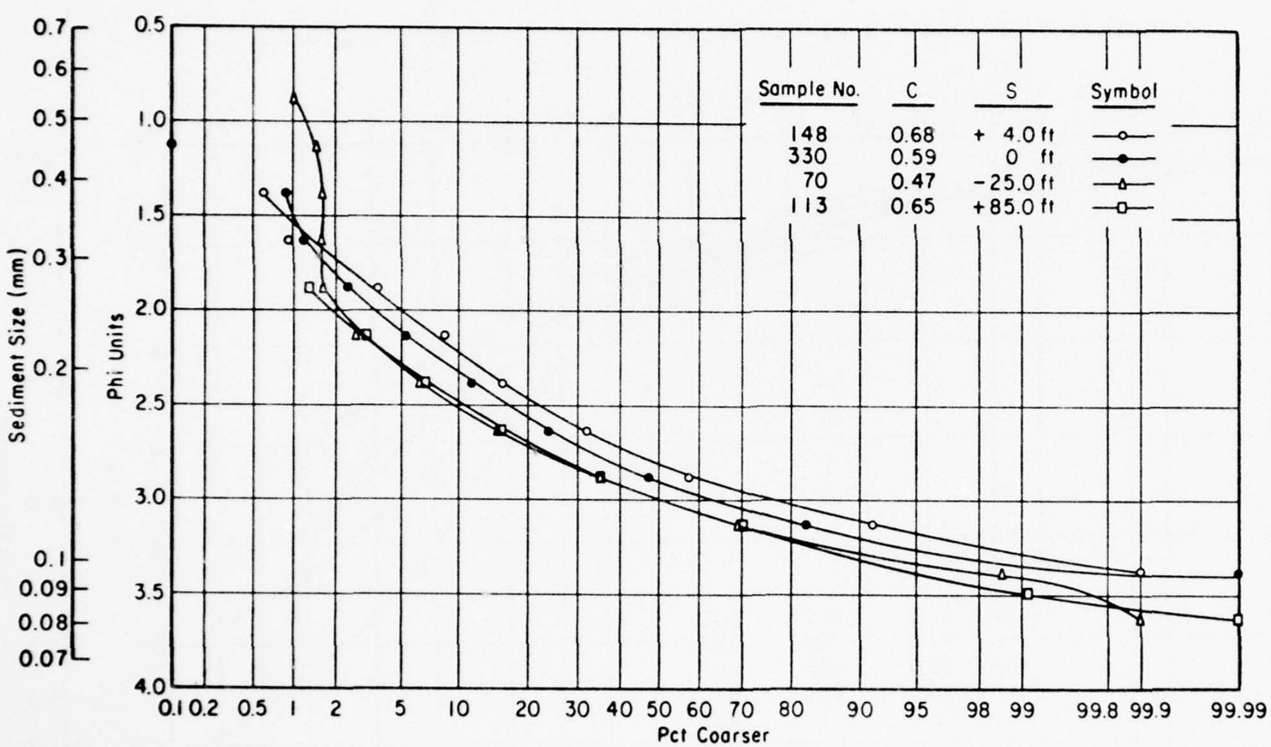

Figure D-5. Range of four breaker zone distances, S, Ventnor, New Jersey.

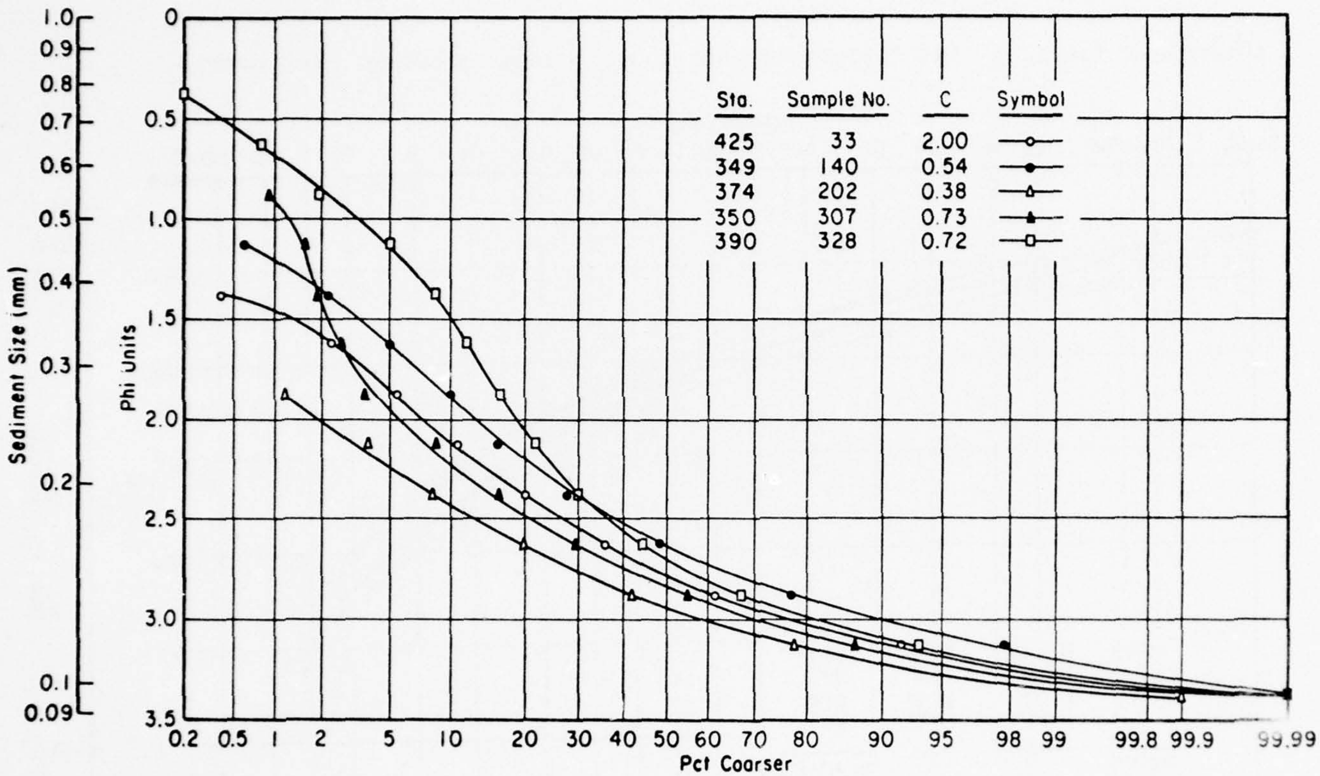

Figure D-6. Range of four sampling stations along pier, Ventnor, New Jersey.

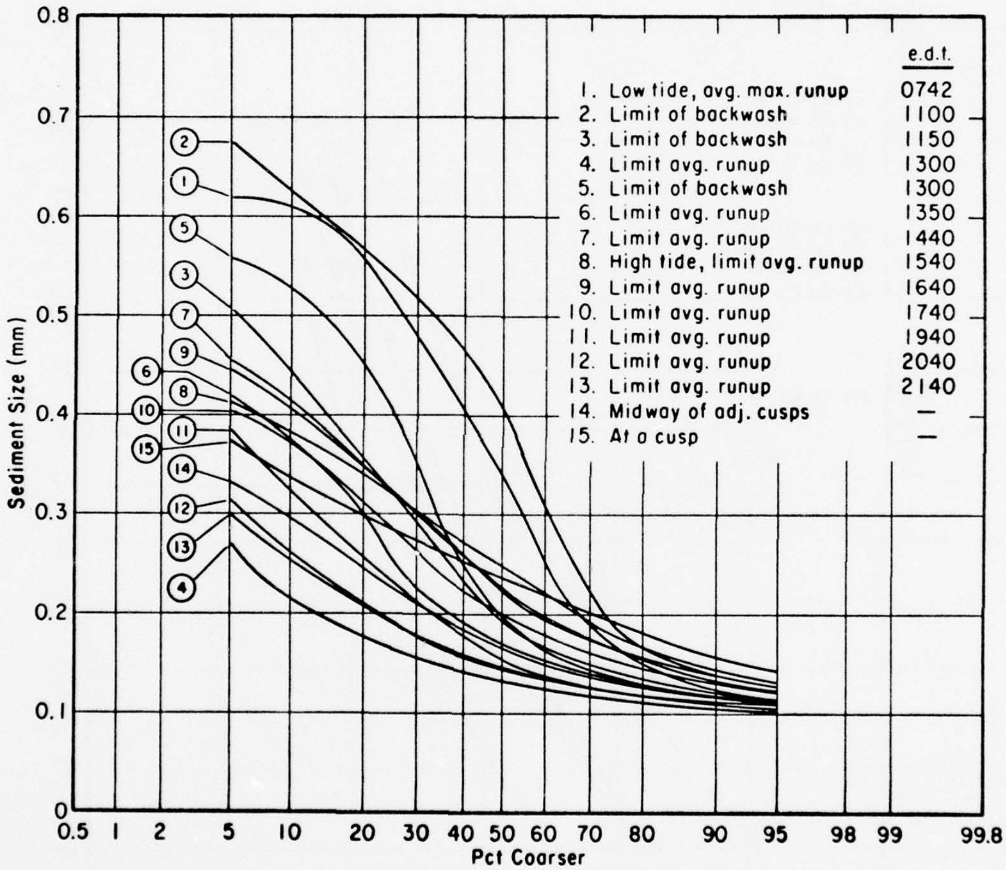

Figure D-7. Twenty-four-hour tidal range surface samples, Ventnor, New Jersey.

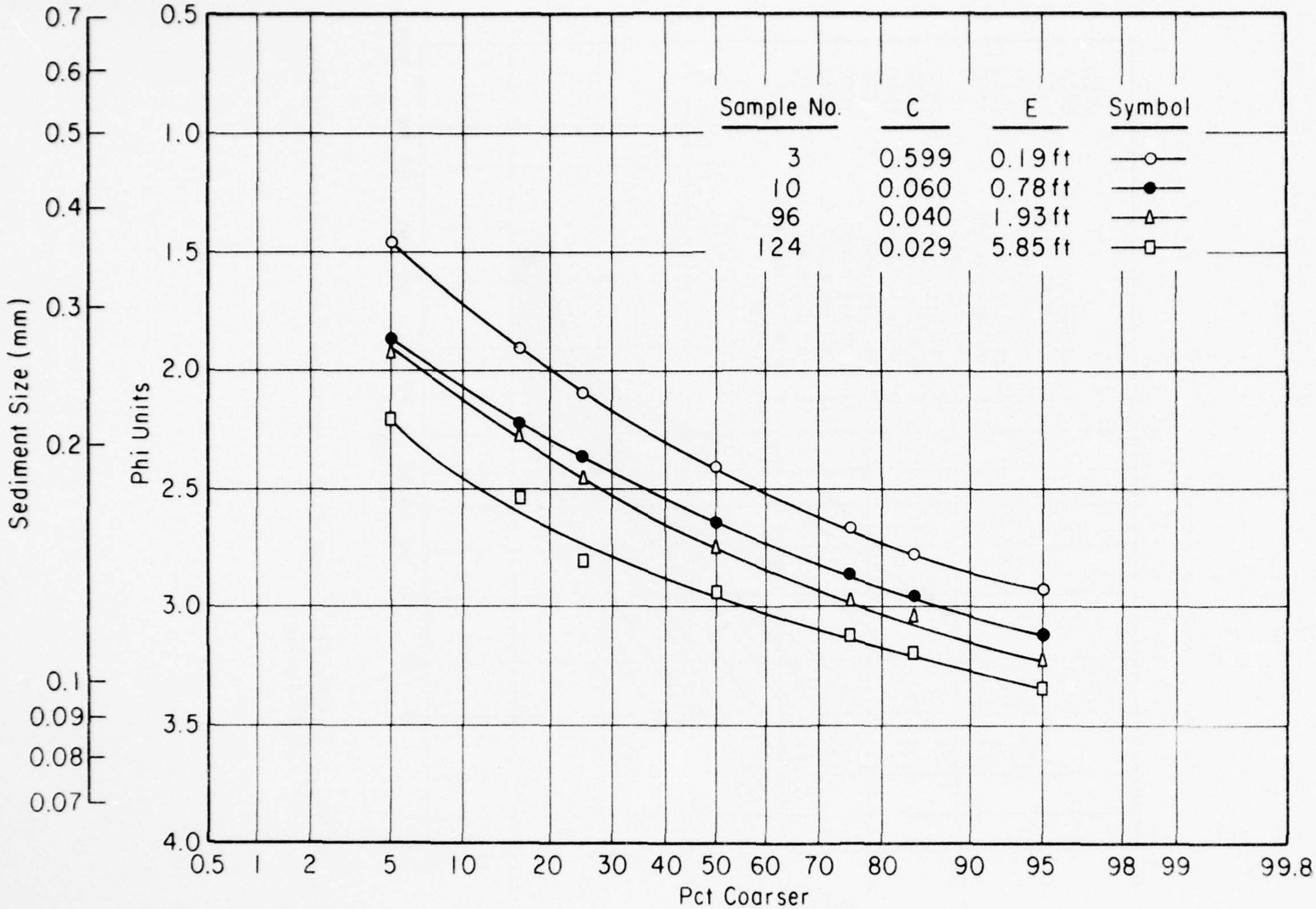

Figure D-8. Range of four nozzle heights, E, Nags Head, North Carolina.

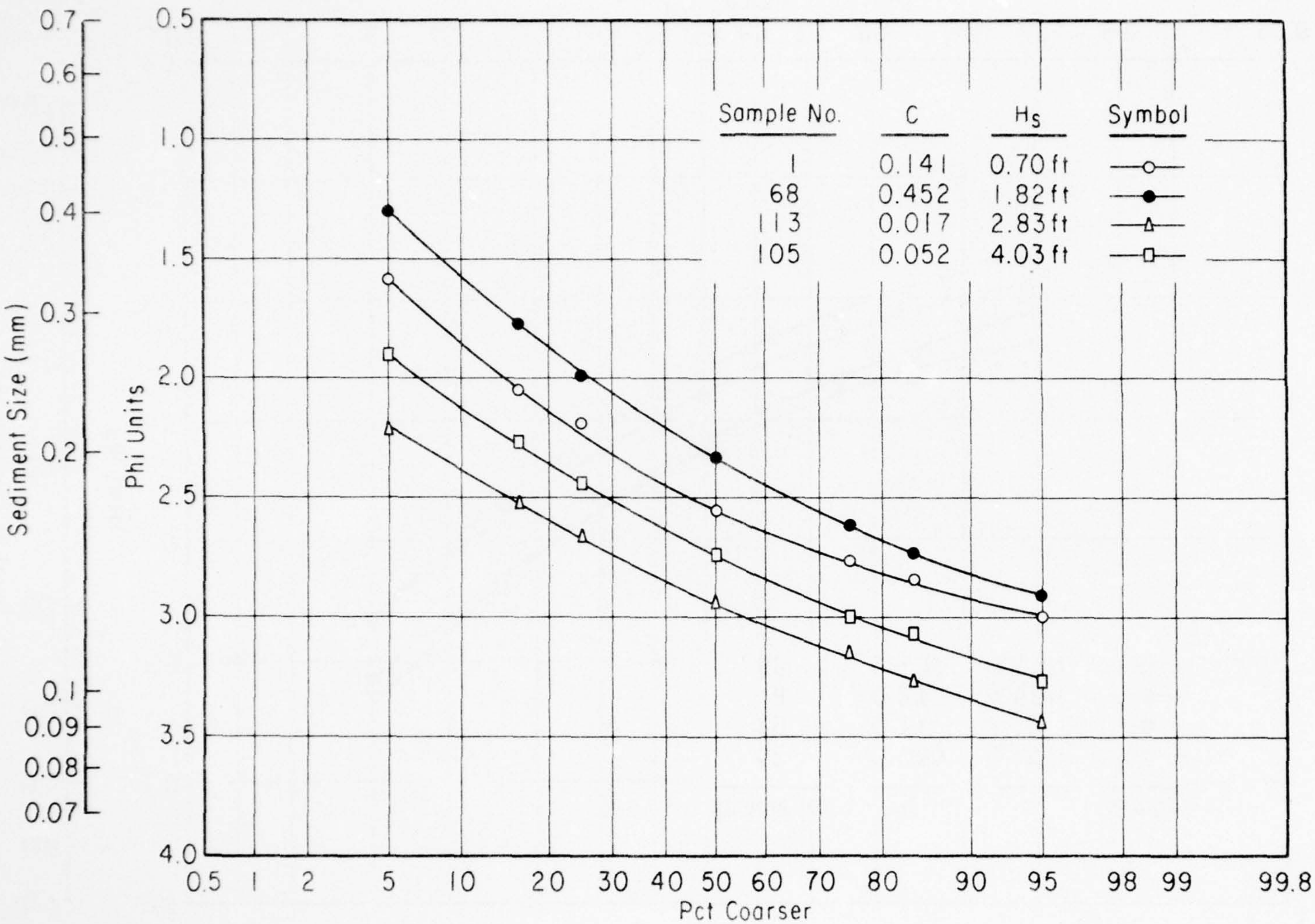

Figure D-9. Range of four wave heights, H_s, Nags Head, North Carolina.

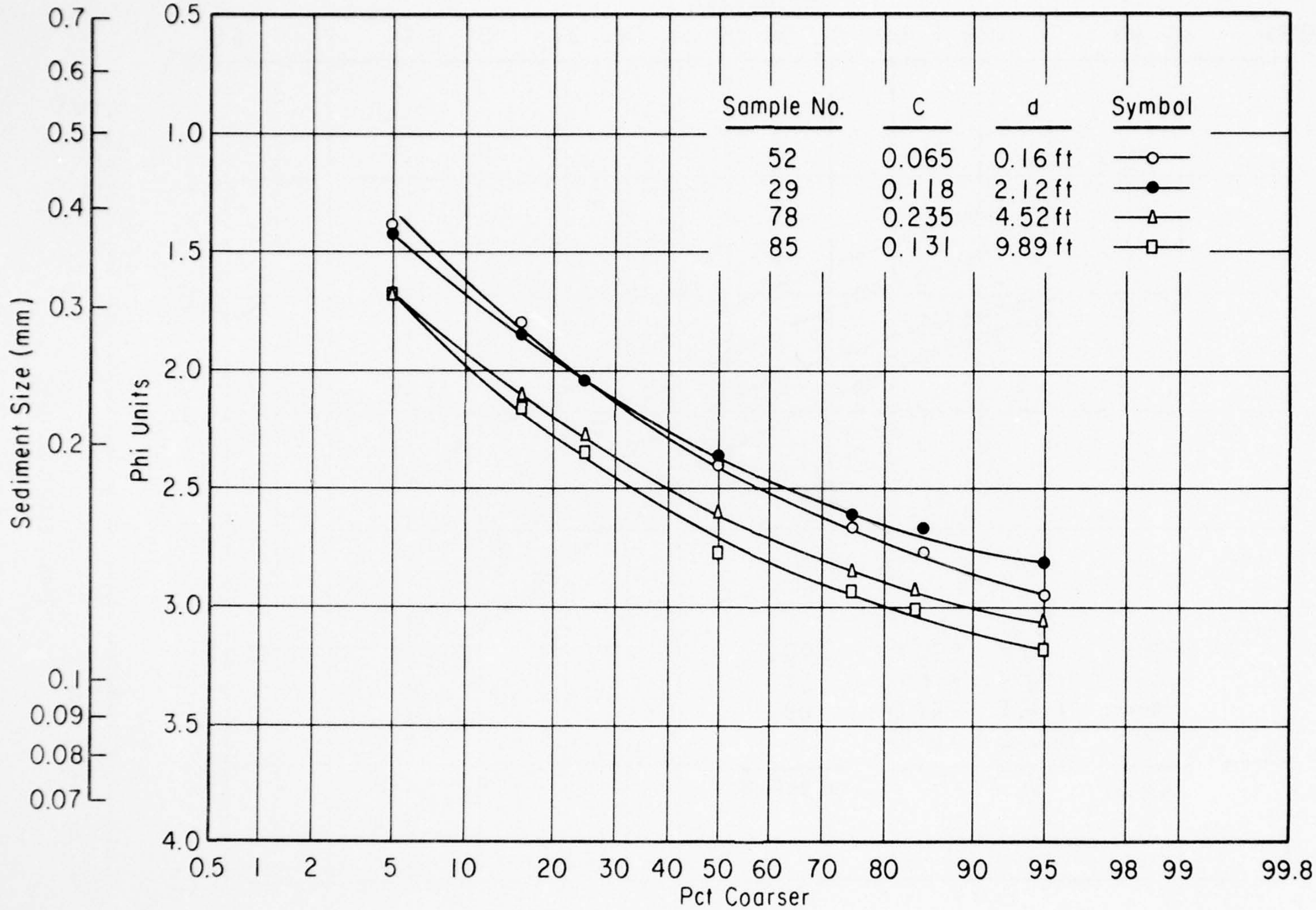

Figure D-10. Range of four water depths, d, Nags Head, North Carolina.

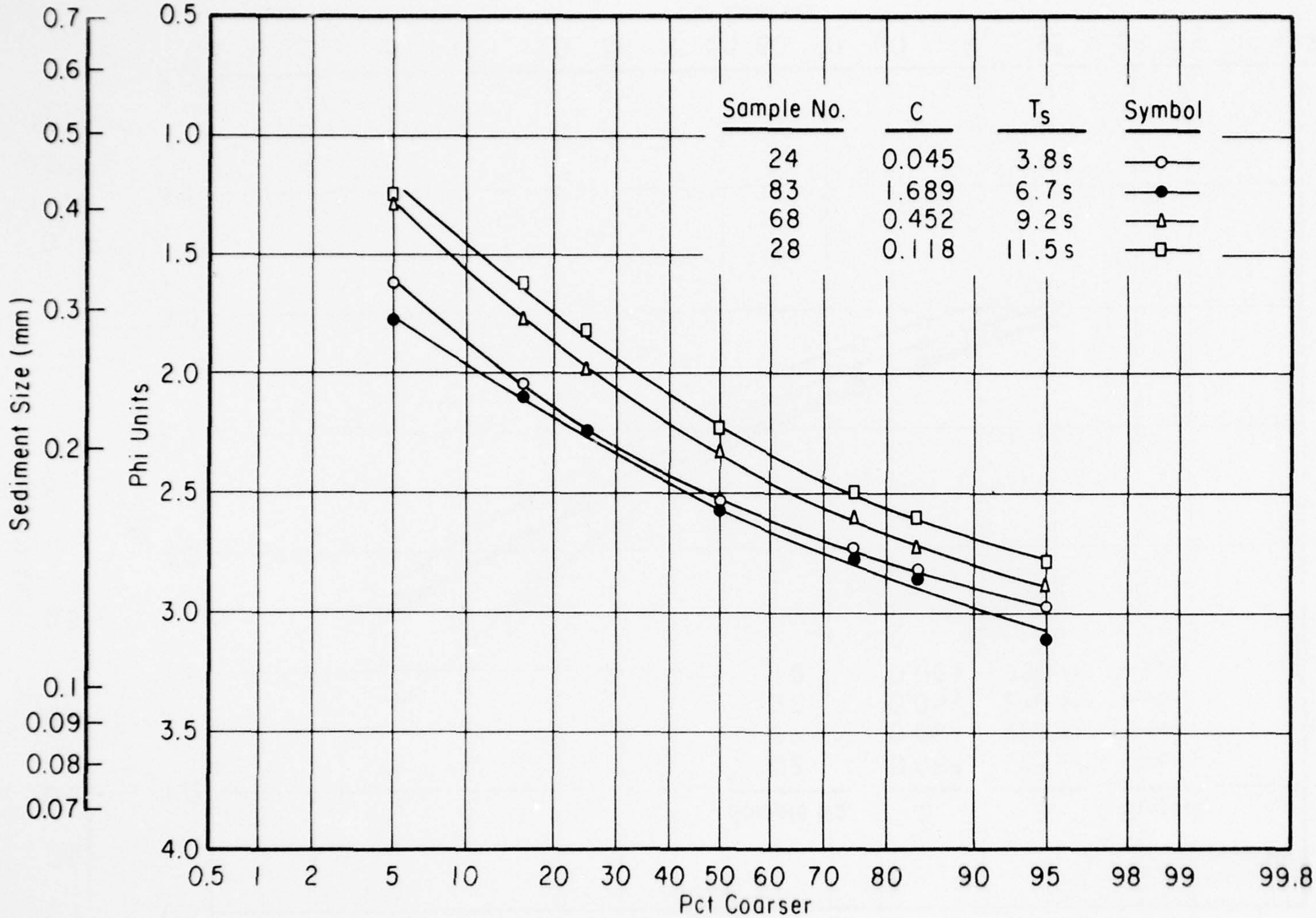

Figure D-11. Range of four wave periods, T_s, Nags Head, North Carolina.

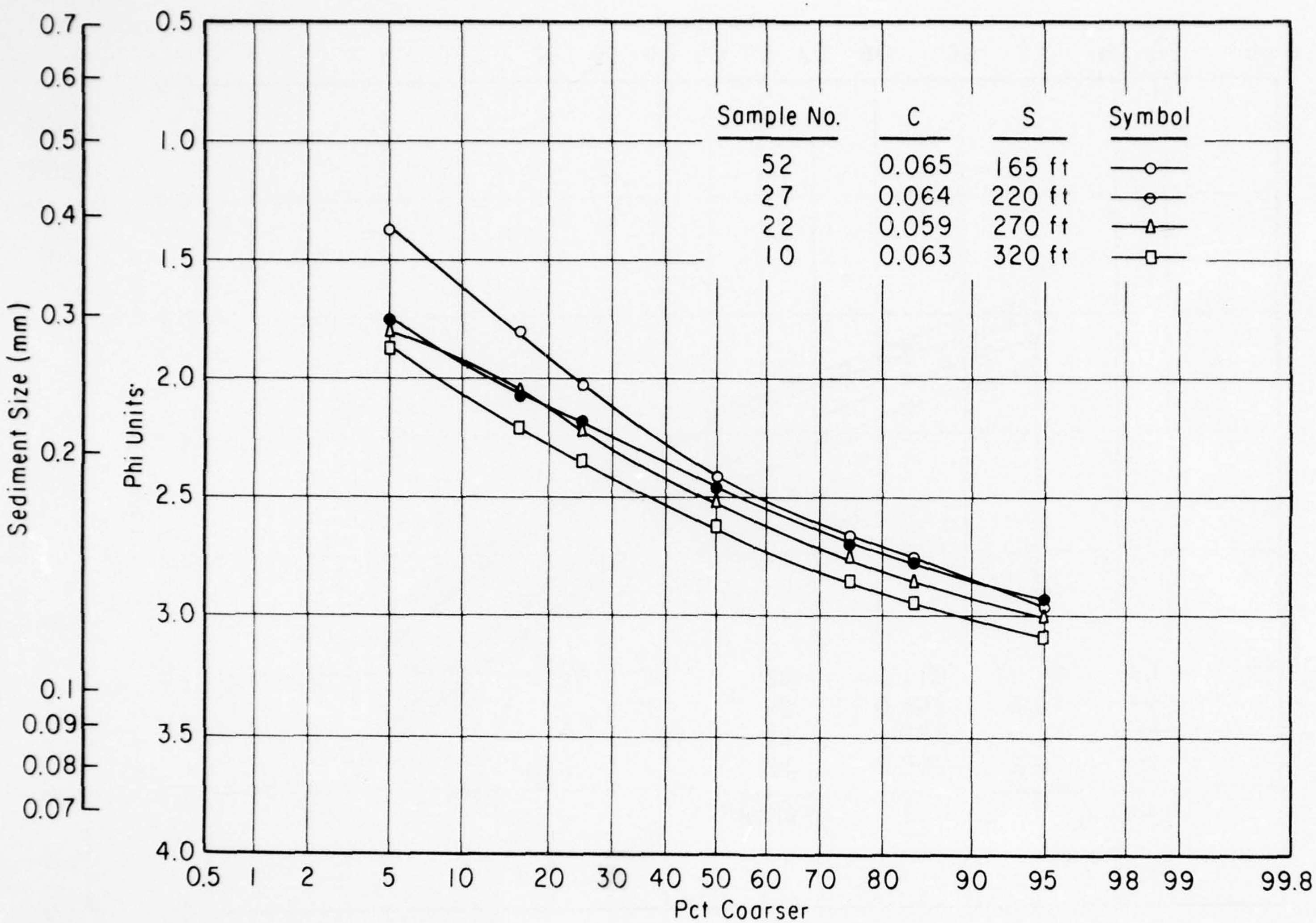

Figure D-12. Range of four breaker zone distances, S, Nags Head, North Carolina.

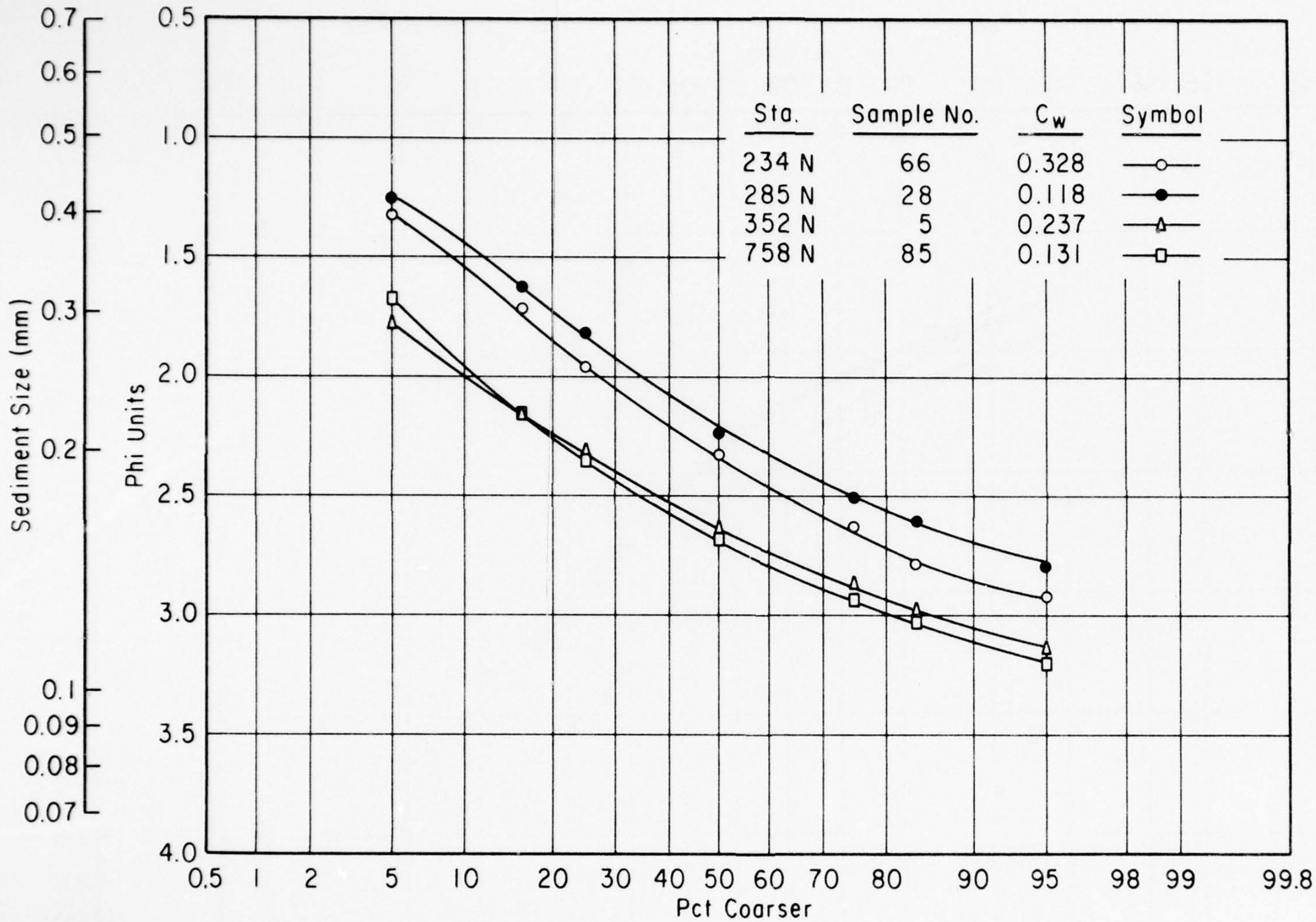

Figure D-13. Range of four sampling stations along pier, Nags Head, North Carolina.

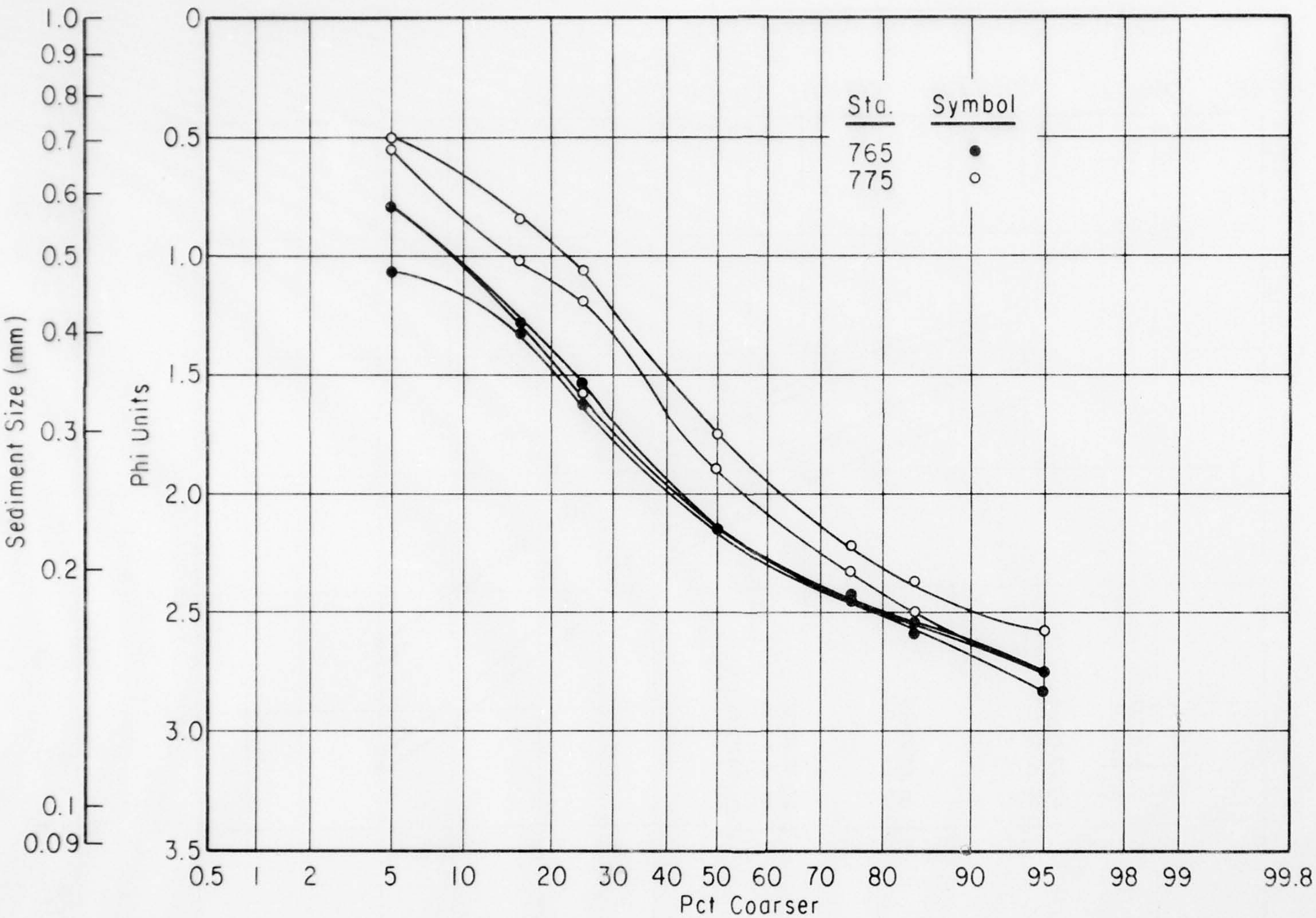

Figure D-14. Bottom samples, stations 765 and 770, Nags Head, North Carolina.

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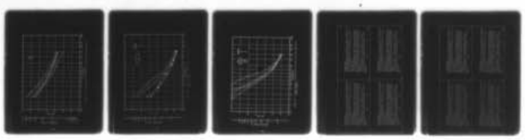

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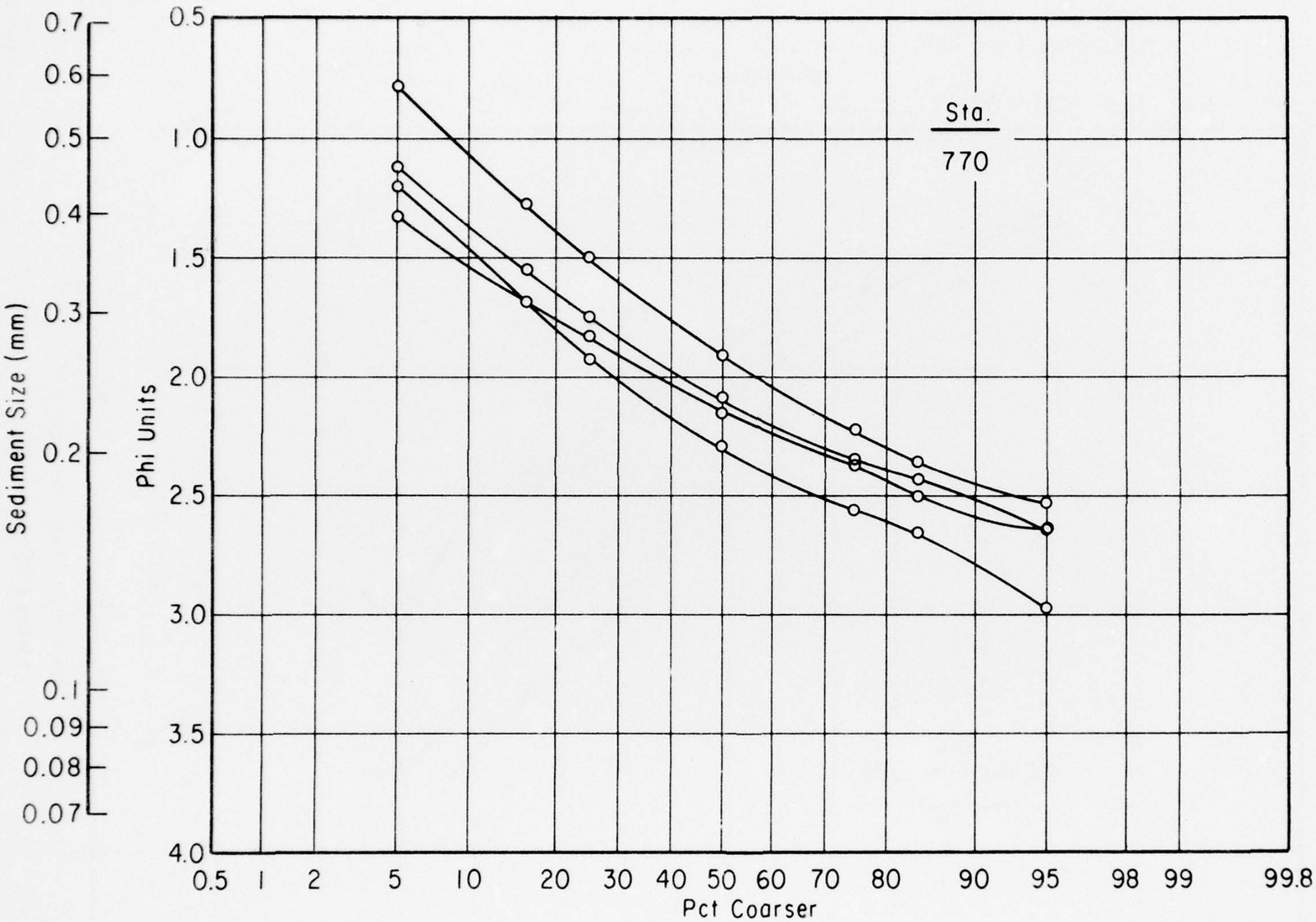

Figure D-15. Bottom samples, station 770, Nags Head, North Carolina.

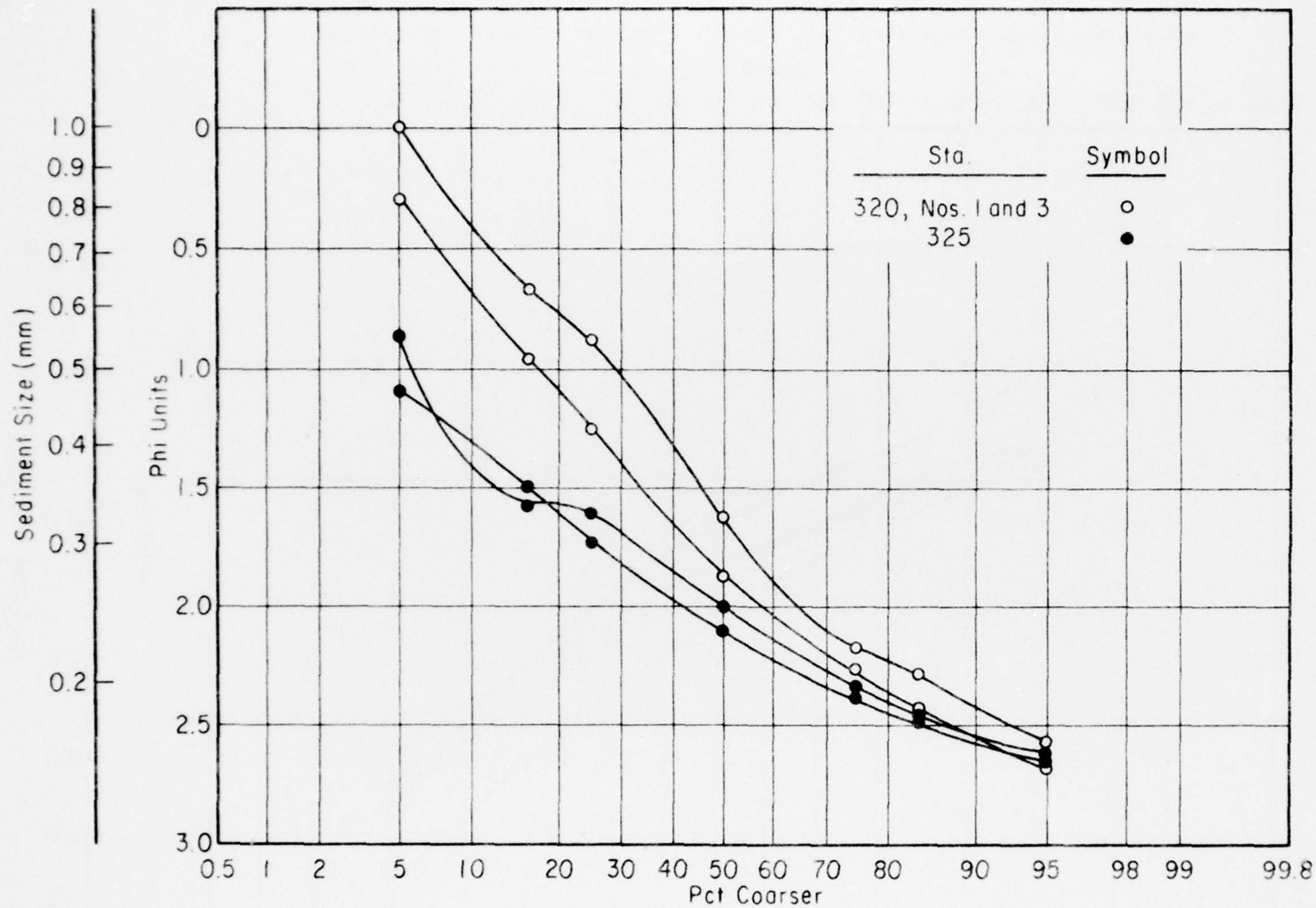

Figure D-16. Bottom samples, stations 320 and 325, Nags Head, North Carolina.

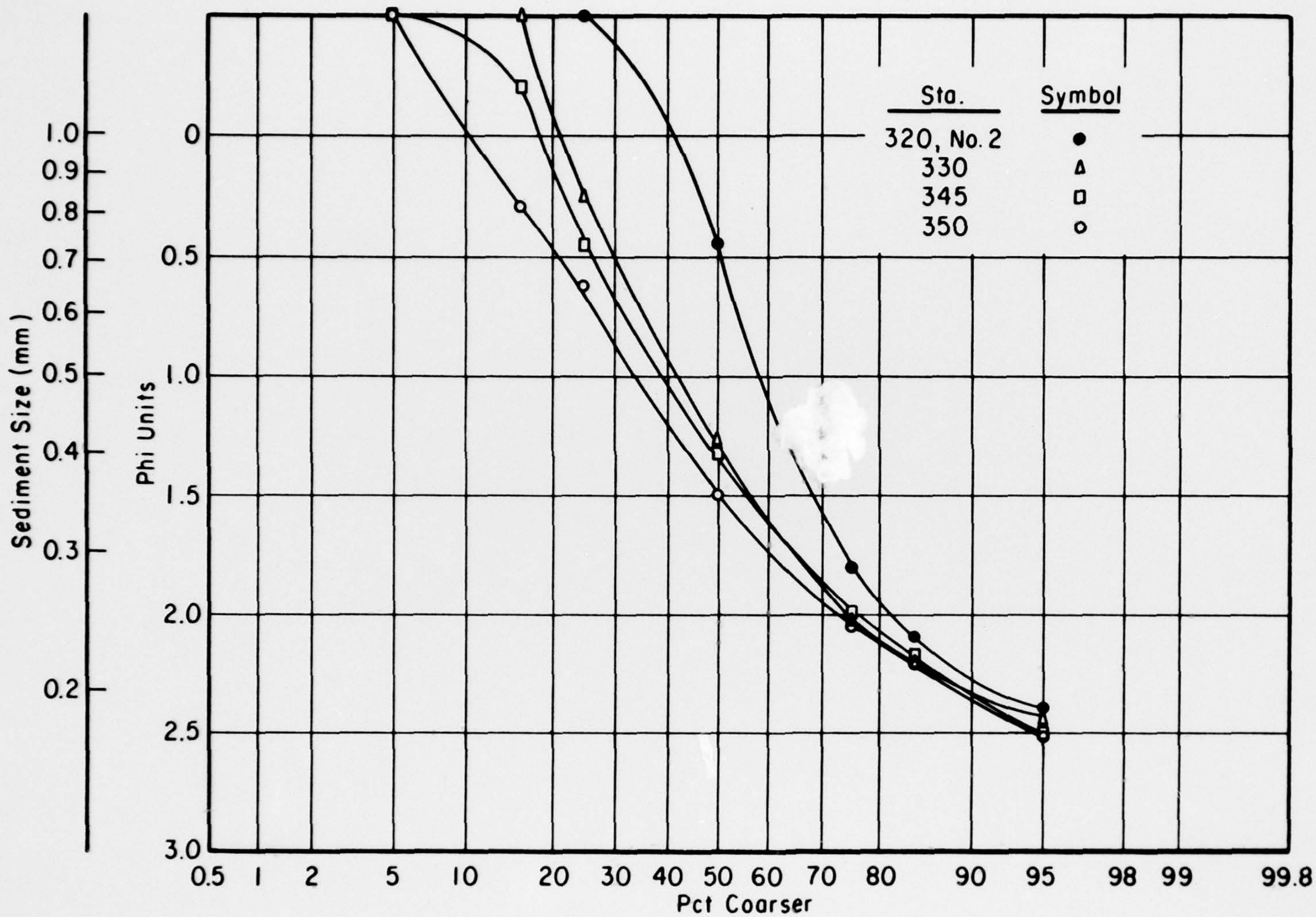

Figure D-17. Bottom samples, stations 320, 330, 345, and 350, Nags Head, North Carolina.

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Suspended sediment in the littoral zone at Ventnor, New Jersey, and Nags Head, North Carolina / by John C. Fairchild. - Fort Belvoir, Va. : U.S. Coastal Engineering Research Center, 1977.
97 p. : ill. (Technical paper - U.S. Coastal Engineering Research Center ; no. 77-5)
Bibliography: p. 49.
This study examines data on sediment suspensions in and near the surf zone at Nags Head, North Carolina, and at Ventnor, New Jersey, using a tractor-mounted pump sampler. The study was conducted to determine the characteristics of such suspensions and to judge the relative importance of sediment suspensions to the total littoral transport.
1. Suspended sediments. 2. Sand - sampling. 3. Samplers. 4. Littoral transport. 5. Nags Head, North Carolina. I. Title. II. Series: U.S. Coastal Engineering Research Center. Technical paper no. 77-5.
TC203 .U581tp no. 77-5 627

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